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Does quality matter (in emerging countries)?

A cross-country analysis of different quality-based trading strategies and the evaluation of the price of quality with a focus on emerging markets.

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ABSTRACT

Given the theoretical foundation, as well as empirical support from previous studies, especially by Asness, Frazzini and Pedersen (2019), this research examines the effect of firm quality on scaled prices. The research is conducted using a sample of developed markets, as well as developing markets. The price of quality is significant across developed and developing markets. The second part of this research establishes a trading strategy of going long in high-quality firms and shorting low-quality firms. The strategy yields significant, positive alphas across all countries, but is subject to large tail risks. Thus, combining this strategy with other factor strategies improves risk-adjusted returns, and greatly reduces tail risks. The quality factor is found to be more pronounced in developing markets.

Key words: Factor investing, trading strategies, asset pricing, momentum, quality, quality minus junk

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1. Introduction to the Research Topic

„Everything works and nothing works.“

Richard Russell

The goal of every investor is to achieve the highest possible returns and to outperform the market. This desire has fueled the research in the field of efficient trading and allocation strategies since the early establishment of capital markets. There exist several economic laws and capital market theories (some of which I will refer to in detail in the second part of this thesis), aiming to predict the movements in financial markets. However, no universal formula X has been found yet which enables us to perfectly forecast the behavior of financial markets. Furthermore, a prevailing opinion in academia is that “prediction, as we commonly think of it, is a totally impossible and futile exercise” (Gunn, 2009, p.3). This reasoning is backed by the efficient market hypothesis stating that all information available in the market is fully reflected in prices (Lo, 1999). This theory is derived from the general behavior of market participants; investors are constantly looking for new information in order to maximize their own wealth and by doing so, they incorporate even the smallest piece of information into the market and quickly eliminate the profit opportunity. Assuming the efficient market hypothesis is true, any market analysis would be useless, and it would be impossible to benefit from novel information, hence “the most efficient market of all is one in which price changes are completely random and unpredictable” (Lo, 1999, p.4), which seems puzzling. However, it has been shown before that financial markets do have trends and that there exist some kinds of patterns, e.g. observable calendar effects or efficiency effects. After decades of research, the economy has not yet come to a clear and common understanding about whether financial markets are efficient or not, which opens up the following question: Are financial markets efficient or do any trading strategies exist that can outperform the market? Through the construction of different trading strategies, aiming to beat the market returns and hence, showing that financial markets are not efficient, this research tries to shed some more light on the question above.

Asness et al. (2019) argue that research in the field of asset pricing has been too focused on trying to explain expected returns rather than market-to-book ratios in the past years. They propose that higher quality stocks demand higher prices and build an investment strategy based on the assumption that high-quality stocks will yield higher than market returns and low-quality stocks (junk stocks) underperform compared to

the market. The quality definition used in their research is defined as a measure of a firms' profitability, growth, and safety (the composition of the quality score is further defined in section three).

This research will firstly examine the connection between a firm's stock price and its quality and then refer to the investment strategy "Quality Minus Junk" (QMJ), proposed by Asness et al. (2019) – a zero-cost strategy which pursues the following logic: buying stocks determined to have high quality and short-selling stocks determined to have low quality. Extensions of this research will be the combination of the QMJ factor with other factors (value, size, and momentum) and the consideration of emerging markets.

Asness et al. (2019) state that higher quality stocks demand higher prices. They analyze this hypothesis across 25 different countries, however, all markets Asness et al. (2019) chose to investigate in their research are represented by developed markets (following the MSCI World developed index). This study will include emerging markets data to investigate whether their findings still hold or are even more pronounced within developing markets. There exist many reasons to consider emerging markets in this research. Firstly "emerging markets are home to over half of the world's population" (Trichet, 2007, p.3), and emerging countries account for almost 60% of the world's GDP with further increases expected (International Money Fund, 2018). Other reasons are positive long-term outlooks or cultural importance, and many more. The connection of the above listed arguments to finance theory is obvious, the global economy is experiencing major changes and new participants are entering financial markets, hence, it is important to consider these new players in order to be competitive. Another reason to consider a rather broad spectrum of countries is the systemic factor that connects our globalized world. In the aftermath of the financial crisis of 2008, this element has become more vivid than ever before. Economies across the globe are interconnected, and positive as well as negative shocks tend to spill over. Giving further examples for this systemic factor are the Tesobonos crisis of Mexico, the Asia crisis, or the bursting of the tech bubble (Trichet, 2007). Lastly, if one would follow the general approach implicating that the world portfolio is the most diversified portfolio to hold, the inclusion of emerging markets is crucial.

There exist contrary findings regarding the existence and persistence of style factors within emerging markets (as discussed further in the literature review section), which is yet another reason to shed some more light on this discussion. Furthermore, Asness

et al. (2019) find especially high 4-factor alphas for the less developed markets in their sample (such as Portugal, Greece, Ireland, or Italy), which have recently or are still facing a crisis (Asness et al., 2019). In fact, the country exhibiting the highest QMJ 4-factor alpha throughout their sample is Greece, which has been downgraded to an MSCI emerging country in 2013 (Reuters, 2013). These findings might be an indication for an even more pronounced quality factor in less developed markets.

Additionally, this study not only investigates this proposal within different markets, but also distinguishes between different industries, sectioned by developed vs. developing countries. In light of fast paced changes and disruptions within emerging countries in the past years, it is interesting to explore whether these countries have different quality expectations within particular industries than developed economies. One example of these rapid disruptions is the tech industry as companies operating in developing countries have rapidly emerged from being “followers in technology” (Pangaro, 2018) to being innovators.

Another extension of this study is to construct variations of the Quality Minus Junk (QMJ) portfolio. I combine this strategy with the portfolio strategy of buying past winners and selling past losers in a cross-country manner, known as the momentum strategy proposed by Jegadeesh & Titman (1993) to diversify across different countries, capital markets, and economies. This strategy is derived from the idea that stocks which are in an upward trend will more likely continue in that direction, rather than move against this trend and vice versa. Furthermore, Asness et al. (2019) find that the three Fama and French factors (1993) are negatively correlated with the QMJ portfolios and combine those portfolios into a combo portfolio in order to benefit from diversification. My research will find different combinations of these factors with the quality factor and maximize the overall Sharpe Ratio by adjusting the weights towards each factor. Further, I will test a cross-country momentum strategy on all quality portfolios. Since momentum strategies are commonly occupied with high volatility, I believe that combining them with the proposed quality measure will strongly lower the overall portfolio volatility. However, the portfolios will not be combined as a combo portfolio like Asness et al. (2019) proposed with the other factors, but the momentum portfolio will be a cross-country portfolio of all in-country QMJ portfolios. More precisely, after applying the QMJ portfolio within each country, I will apply a momentum strategy across those portfolios.

Lastly, this research investigates an alternative measure of firm quality, namely environmental, social and governance performance (ESG). “For investors, ESG data is increasingly important to identify those companies that are well positioned for the future and to avoid those which are likely to underperform or fail” (Forbes, 2018). In light of the aftermath of some of the biggest scandals in corporate history, such as the VW diesel scandal or the Cambridge Analytica data scandal, I decided to add ESG factors to my analysis as an additional quality factor to find out whether sustainability “pays off”. It is still an established thought that the condition of “impact” or social responsibility into the investment process will result in either lower financial return or higher risk. However, this trade-off does not necessarily have to exist. For example, the impact fund Mustard Seed has originated the concept of the Virtuous Venture Cycle (VVC), with which they argue that there is a positive reinforcement cycle with impact investing since consumers and employees are more supportive towards businesses with similar values as themselves, spurring shareholder support as earnings grow. As a result, social oriented ventures gain a competitive advantage (in terms of reputation, revenues and costs). The impact approach also minimizes the probability of having legal costs that are subject to environmental or other illegal issues (Mustardseed, 2016). I believe that the change in societies virtues towards a more sustainable living is reflected in the financial markets and that more sustainable firms will achieve superior returns. Further, the importance of responsible investing has been constantly rising in the past years and “today, ESG investing is estimated at over \$20 trillion in AUM [...] around the world and its rapid growth builds on the Socially Responsible Investment (SRI) movement that has been around much longer” (Forbes, 2018).

I believe that using all portfolio strategies mentioned above will lead to superior risk-adjusted returns as compared to a combo strategy since it diversifies across different markets.

My research is structured as follows:

First, I present a literature review of all literature relevant to the development of modern portfolio theory and highlight the relevance of my research. Furthermore, the literature review also discusses factor investing and factors in developing markets. The second chapter of this thesis evaluates the problem statement of my research and formulate the relevant research questions. Next, I explain the used methodology and list the relevant data sources, followed by the presentation and discussion of the

findings. After a conclusion, I highlight the importance of my findings and discuss implications for future research as well as limitations of my research.

2. Literature review

To be able to find efficient trading strategies, it is important to accurately evaluate financial markets. There exist two major approaches in analyzing financial markets, the fundamental and the technical approach. The fundamental method uses data such as financial statements, industry analysis, and macro-economic factors to predict future stock market movements by evaluating the intrinsic value of a company, whereas the technical approach is based on the fact that all fundamental data is already represented in the market prices, thus it uses past return data and other indicators. In addition to these approaches, there are several portfolio theories and capital market models, the most important ones are reviewed in the following section.

2.1. The history of portfolio theory

„The CAPM is wanted, Dead or Alive.“

Eugene F. Fama and Kenneth R. French

One of the oldest and most important portfolio theories is the Dow Theory which stands in great contrast to the Random Walk Theory mentioned before. The Dow Theory is considered by many as the foundation of technical analysis and most of what we know today as technical analysis has its roots in the Dow Theory. Charles Dow was the first person to discover that the overall market trend reflects business conditions which are an indicator of the markets' future development. However, trading strategies based on the Dow Theory have not been found to yield superior returns when compared to buy and hold strategies (Cowles, 1993). There are six major findings to this theory. The first is that market prices incorporate all available information and, second, that markets have trends. Third, Dow divides trends into three phases, an accumulation phase, a public participation phase, and a distribution phase. The accumulation phase occurs when investors who know about the future stock movement are actively buying or selling the stock against the public opinion. During the accumulation phase, the stock price does not change much since the majority of the market has not started trading the stock yet. During the public participation phase, the public catches on to the investors and the price rapidly starts to change. In the final phase, astute investors begin to distribute their shares in the market. The fourth

underlying finding is that stock market averages must confirm each other and move, on average, in the same direction. Fifth, trends are confirmed by volume, meaning that the trading volume should increase once the price moves in the direction of the trend and decrease once the price moves in the opposite direction. The intuition behind this is that traders are more willing to buy an asset if they believe that an upward movement will continue and vice versa. Finally, trends exist until there is definite proof that they have ended (Cowles, 1993). The Dow Theory has later been revised by Brown et al. (1998), with the finding that Cowle's research had flaws and that the Dow Theory indeed does yield superior returns compared to the overall market.

The core of Modern Portfolio Theory is the relation between risk and return, which was first developed by Harry Markowitz (1952). Markowitz believes that achieving the highest possible return is not the single determinant to value portfolios but that investors should more importantly be concerned about mean-variance optimization. Hence, the most desirable portfolio is the one with the highest (mean) average return and the lowest mean variance. The finding of this relation has been a major step in financial theory since it implies that a portfolio's mean variance is the appropriate risk measure for financial assets (Hillier, 2012). According to Markowitz, the contribution of a single asset to the overall portfolio should be the major factor of investment decisions, broadly known as mean-variance analysis. Building on Markowitz' findings, we can define mean-variance efficient portfolios which yield a higher return with lower risk compared to the "dominated portfolios" which are either inferior in terms of returns, volatility, or both. Markowitz' work also implicates another cornerstone of modern financial theory which is diversification. Holding assets with largely uncorrelated returns strongly reduces the risk of the overall portfolio.

Mean-variance analysis is also the backbone of the most famous asset pricing model, the Capital Asset Pricing Model (CAPM). The CAPM reveals that it is not a specific asset's own variance that is important, but rather the covariance of that asset's return with the market return, which is measured by that asset's beta. This argument has been found by Sharpe, Lintner, and Mossin in the 1960's. Hence, beta is the measure of risk that determines the extra yield that has to be added to an asset's return above the risk-free rate and, therefore, represents the appropriate cost of capital for a given stock (Hillier, 2012). Even though the CAPM has been a major step towards modern financial theory, it is subject to multiple criticisms as it lacks ability of explaining asset returns. The main explanations for the CAPM's bad performance are anchored in the

theory that the proxies for the market portfolio do not capture all “relevant risk factors in the economy” (Hillier, 2012, p.155).

2.2. Factor Investing

„When did our field stop being “asset pricing” and become “asset expected returning?” ... Market-to-book ratios should be our left-hand variable, the thing we are trying to explain, not a sorting characteristic for expected returns.”

Cochrane, American Finance
Association

In the meanwhile, a different kind of trading strategy has evolved which is commonly known as factor investing. There are some factors that have shown to be persistent drivers of returns and can help to accomplish different investment goals such as improving diversification, increasing returns, or reducing risk. The above-market performance of factors can often be explained by three major attributes: additional risk, structural impediments, and (irrational) investor behavior (Blackrock, 2019). Many factor investing strategies are based on long-short investing and are therefore zero-cost strategies, which makes them even more appealing to investors. These factors can be divided into two major classes: macro factors (such as inflation or real rates), which are persistent throughout all asset classes, and asset class specific style factors. The two most well-known style factors have been discovered by Fama and French in their study from 1993, in which they extended the CAPM model by adding two more factors: value and size. While conducting their studies, Fama and French discovered that two classes of stocks have tended to perform better than the market as a whole: small-capitalization stocks and stocks with a high book-to-market ratio (value). In their work “The Cross-Section of Expected Stock Returns”, Fama and French argue that the linear relationship of an asset’s returns and its beta (CAPM) disappears when taking into account the effects of size and book-to-market ratio.

Following the value and size factors, the alternative concept of momentum investing arose. Jegadeesh and Titman (1993) propose a portfolio strategy of buying past winners and selling past losers, which is known as momentum strategy. This strategy is based on the theory that stocks which have been in an upward trend in the past will continue to do so and that stocks which have been in a downward trend will also continue to follow a declining trend in the future. Hence, an investor takes a long position in stocks that have shown the upward trending price (buying the winners) and a short position

in stocks characterized by the downward trend in the same time-period (selling losers). Although momentum has proven to yield high returns, it is also occupied with high tail risks. When solely relying on volatility as a measure of risk, momentum portfolios seem to be superior to all other factors, however, volatility is a poor risk measure when it comes to momentum investing. Momentum strategies are occupied with large tail risks e.g. expressed in excess kurtosis and large minimum values (Barosso and Santa-Clara, 2015) resulting in large but infrequent crashes. Major tail risks arise when losers outperform winners or due to the tendency of buying overvalued stocks and selling undervalued ones.

Alongside all other factors mentioned in the previous section, this thesis sets its focus on the newly discovered style factor, quality. The research paper “Quality Minus Junk” by Clifford S. Asness, Andrea Frazzini, and Lasse Heje Pedersen (2017), is the core of this research. The quote used in the beginning of this chapter perfectly introduces their research topic, which is whether high-quality stocks demand higher prices. Asness et al. (2019) define three quality measures, namely growth, profitability, and safety to measure the quality of a company. After testing how quality affects stock prices, they also construct a portfolio where they go long in high-quality and short in junk stocks. This QMJ factor yields highly significant risk-adjusted returns.

2.3. Factors in emerging markets

Even though the relative size of economies around the world is experiencing a substantial shift towards emerging markets (Johansson et al., 2012), only few researches have been dealing with factor investing in developing regions. Furthermore, research papers available so far show controversial findings regarding factors in developing markets. The following paragraph discusses the most noteworthy findings. One of the first globally extended studies of style factors around the world was conducted by Fama and French in 2012, when they investigated size, value, and momentum returns across four regions, however, covering only developed markets. They show that the value and momentum factors are significant in all countries except Japan and insignificant results for the size factor.

The momentum factor has been the most researched factor across emerging markets. Andy Naranjo and Burt Porter (2007) find significant positive returns and diversification benefits from momentum strategies in emerging markets. Luis Muga and Rafael Santamaria (2007) analyze the momentum effect within Latin American emerging countries and prove positive significant results. In 2010, Chui et al. find

mixed results when conducting a research on momentum returns in developing markets.

However, there are also some studies conducting research on other factors within emerging countries. In 2015, Hanauer et al. provide evidence of positive, significant effects of the momentum factor across emerging markets, weak effects resulting from the size factor, and highly significant, positive effects resulting from the value factor. Furthermore, they conclude that the value factor is even more pronounced in emerging markets when compared to developed markets. Another study from 2012, conducted by Groot et al., finds significant value, momentum, and size effects across 24 frontier markets. Frontier markets are countries even less developed than emerging markets.

In contrast, Cakici et al. (2016) conduct research regarding the value, momentum, and size factors in 18 emerging markets and show that size and momentum are not present in emerging markets and that the value factor is present in all emerging markets conducted except for Brazil. Zaremba and Konieczka (2015) find that size and momentum premiums in CEE emerging markets disappear when adjusting for the impact of illiquidity and transaction costs and only the value premium survives.

The research of Vaibhav et al (2018) investigate quality investing in the Indian market and find that two out of four quality strategies beat the market return. However, their definitions of quality deviate from Asness et al. (2019) and consequently from the definition of quality used in this research. Furthermore, their sample only comprises companies included in the BSE-500 index, which excludes a large universe of companies that are not included in the index. Another problem with using only index companies for researching factor strategies is the exclusion of the risk of dying companies, which is commonly known as “survivorship bias”.

To conclude, the study of the quality factor within emerging markets is novel and will add important findings to existing works.

2.4. Socially responsible investments as a factor strategy

There exist three approaches of socially responsible investments. The least strict approach involves negative screening, which is the exclusion of “bad” companies, such as weapon or tobacco producers, from the investment portfolio. A more drastic approach is called positive screening, hereby the investor actively picks stocks that comply with predefined social, environmental and governance standards. These specifications can be generalized as ESG measures. There exist several databases that developed an ESG scoring system to rank companies based on their ESG performance. There are different approaches in terms of the implementation of

positive screening to investment decisions e.g. to only invest in companies with an ESG score above the median or a certain cut-off or the implementation of a long/short factor strategy as proposed in this research. While ESG criteria are a set of standards that can gauge the sustainability of a company's operations and signal exposure to growing risk factors, impact investing goes one step further and aims not just to invest sustainably, but also making an actual positive impact alongside the financial return. To qualify as an impact investment, the given company's primary business objective has to be a solution or product with measurable social or environmental impact.

Van Duuren et al. (2015) examine the connection between sustainability and company performance. According to the study, improper corporate governance and bad social and environmental externalities should have a negative impact on a firm's earnings and abilities to conduct business (van Duuren et al., 2015). Moreover, Van Duuren et al. (2015) find that there is a positive performance when considering ESG factors in investment decisions. However, they also find that ESG factors are mostly used to identify red flag companies rather than as a positive sorting variable. Eccles et al. (2014) find that sustainable companies significantly outperform less sustainable firms in terms of stock returns. Another study in favor of responsible investments was conducted by Kumar et al. (2016). According to their research, companies incorporating ESG guidelines show lower stock volatility and higher returns when compared to their peers. Since the focus of this research is on emerging market countries, it will also be interesting to see whether the implementation of ESG standards differs when compared to developed markets. Sherwood et al. (2017)'s research indicates that portfolios considering ESG principles find higher returns and lower downside tail risk when compared to portfolios without any consideration of ESG within emerging markets. Lastly, a study by Friede et al. conducted in 2015 combines the findings of over 2,000 researches on the connection of ESG and financial performance and conclude that, even though past studies do not all agree a common consensus, the overall general trend reports positive findings.

All above-mentioned literature is focused on the connection between ESG and individual company performance, however, research examining the relation between ESG practices and investment portfolio performance is rather scarce.

Literature regarding ESG investing includes the research of Amel-Zadeh and Serafeim (2018). According to their research, negative screening achieves the least benefit in terms of risk and return when compared to more active approaches. Further, Kempf et al. (2007) find that companies with high social ratings score abnormal returns.

However, this study has excluded contentious industries, such as the tobacco or alcohol sector from their study, which distorts their findings. On the other hand, Auer et al. (2016) propose that there is no evidence of a superior risk-adjusted performance through an active selection of stocks with high or low ESG stocks. Active stock selection based on ESG performance results in similar to market performance within the U.S. and the Asia-Pacific region and below-market performance within Europe. To conclude this section, while the implementation of ESG guidelines seems to pay off on the level of individual firm performance, the impact of ESG practices for investment portfolios remains unclear, which is why this study tries to shed some more light on this question.

3. Data and Methodology

Firstly, the two major research questions will be presented, then data sources will be discussed, and, finally, the methodology and all subordinate research questions will be explained.

3.1. The research questions

The following paragraph will further explain the methods used to analyze the two major research questions.

- 1) Do high-quality stocks across different countries demand higher prices?

To answer the first research question, whether high-quality stocks demand higher prices, the following regression is used, where $P_{i,t} = \log(BM_{i,t})$, market-to-book is defined as the current market value of equity of the firm in year t divided by the company's book value. The calculation of the quality and price measure is further explained in the methodology part.

$$P_{i,t} = \alpha + \beta Quality_{i,t} + \mu_i + \varepsilon_{i,t} \quad (1)$$

The regression coefficient β measures the percentage increase in market-to-book associated with a one standard deviation increase in the quality score. μ measures the variables that affect P cross-sectionally but does not vary over time (fixed effects).

The regression will test the Alternative Hypothesis that $\beta > 0$ against the Null Hypothesis that $\beta = 0$.

-
- 2) Will QMJ and other quality-based trading strategies yield positive abnormal returns?

The second part of this thesis tests different trading strategies associated with the Quality Minus Junk theory. To investigate whether the QMJ portfolio (and other combinations) returns experience positive abnormal returns, I will test the Alternative Hypothesis of $\alpha \neq 0$ against the Null Hypothesis of $\alpha = 0$. To do this, I will run the following regressions:

$$rQMJ_t = a + \beta^{MKT-rf} MKT - rf_t + \varepsilon_t \quad (2)$$

$$rQMJ_t = a + \beta^{MKT-rf} MKT - rf_t + \beta^{SMB} SMB_t + \beta^{HML} HML_t + \beta^{UMD} UMD_t + \varepsilon_t \quad (3)$$

Where $MKT-rf$ resembles the proxy market excess return of the CAPM regression and equation (3) is based on the Fama and French 4-factor model. QMJ represents pure QMJ portfolios, and this equation is exemplary for all other portfolio construction that will be tested in this research. The methodology used for the portfolio constructions is further explained in part 3.3.2.

3.2. Data

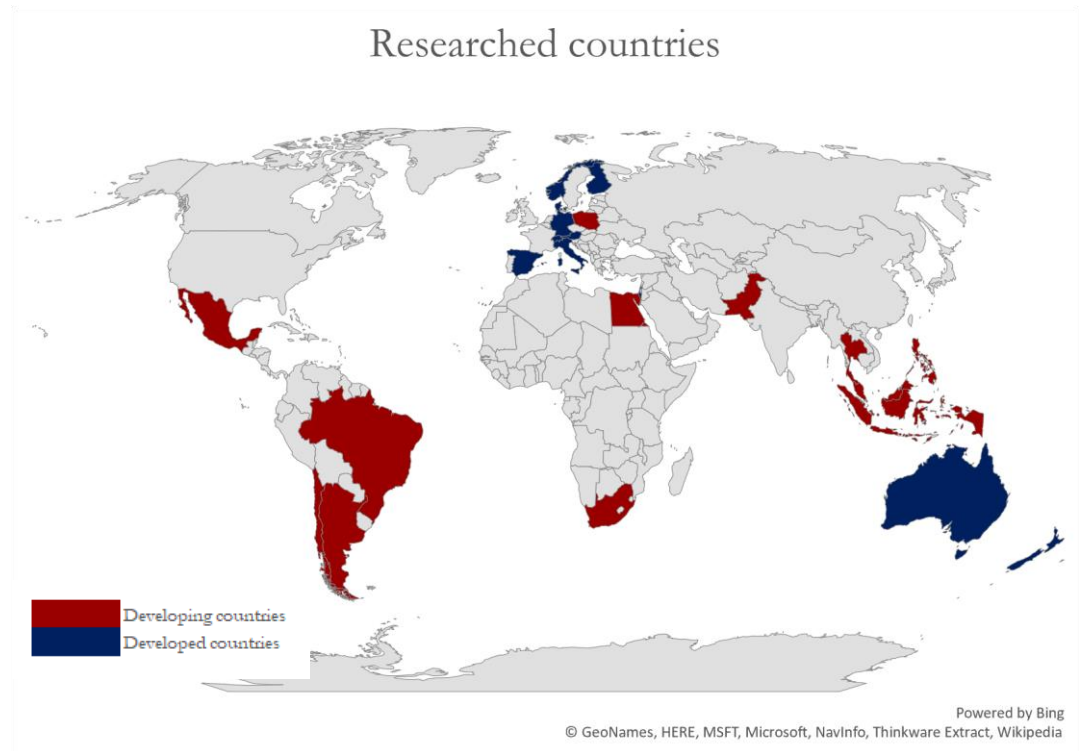
The main data sources used are Compustat Global fundamentals and daily prices, where the fundamental data is based on yearly publications. Data for the past 18 years across 24 different countries, which are displayed in Figure 1, is used. Table 2 displays general information for all countries in the sample and Table 3 discusses reasons for the inclusion of each market. The industries used for the research are defined in Table 1 (identified by the Global Industry Classification Standard GICS). Financials have not been excluded from the sample, following Asness et al. (2019).

Table 1: GICS industry specification

| GICS | INDUSTRY |
|-------------|----------------------------|
| 10 | Energy |
| 15 | Materials |
| 20 | Industrials |
| 25 | Consumer Discretionary |
| 30 | Consumer Staples |
| 35 | Health Care |
| 40 | Financials |
| 45 | Information Technology |
| 50 | Telecommunication Services |
| 55 | Utilities |
| 60 | Real Estate |

Stock prices have been translated in the same currency, namely Euro, to hedge for currency risk. The currency exchange rates are retrieved from Datastream. The data for the market indices and ESG data is also retrieved from Datastream. The rather short time period (1999 – 2017) of the sample is due to the inclusion of emerging country data, which, for most emerging countries is not widely available for a long time period. Furthermore, since the Euro was only introduced in January 1999, this year is set as starting point of the analysis. Currencies could have been translated back before 1999 using a currency called the Synthetic Euro. Warburg Dillon Read (a former U.S. investment bank) has calculated a synthetic series for the Euro against the U.S. Dollar calculating exchanges rates for the Euro synthetically backwards from its introduction date. The WDR Synthetic Euro is a currency basket which is weighted by fixed purchasing power parity GDP weights of the Euro countries. However, I prefer to keep the dataset clean and only use actual Euro exchange data as predictions could deviate from true values.

Figure 1: Countries that have been selected to conduct this research



To calculate the three factor Fama and French regression, the global ex. U.S. factors are retrieved from the Kenneth French website and the risk-free rate used is the 10-year US Treasury Bill. Those values have also been translated into Euro.

ESG scores have been assigned since 2002 (always reporting the score for the previous year) and are available for over 7,000 companies on Datastream (Thomson Reuters, 2018). Thomson Reuters uses over 400 different ESG factors to quantify the final score, and sources such as annual reports, company webpages, CSR reports and many more are used to collect data. The ranking is divided into three major pillars with sub-scores: Environmental (Resource Use, Emissions, Innovation), Governance (Management, Shareholders, CSR Strategy) and Social (Workforce, Human Rights, Community, Product Responsibility) (Thomson Reuters, 2018). The scores within the different sub categories are then weighted in proportion to their amount of input factors to find an overall score for each pillar and ranked relative to other companies within the industry group (for the environmental and social score) or companies within the same country (for the governance score). Finally, an overall ESG score is achieved through averaging the score of the three major pillars.

In order to study the quality premium within developing markets, the sample of 24 countries is split in half, 12 developed countries and 12 developing countries. The reason for including developed countries in the sample is to have a more exact dataset

for comparison between developing and developed markets as quality measures and time periods deviate from Asness et al. (2019) as further explained later. This approach also allows to profit from higher-than-average growth in developing countries, while at the same time gaining from the stability resulting from economies with stable and developed capital markets when building the momentum portfolio. Since it is hard to define developing markets if following the MSCI developing markets index, as countries move in and out of the index on a regular basis, this research is not basing the country selection on the exact MSCI developing index but rather uses countries that have been or are included in the index over a longer time span during the observation period.

3.3. Methodology

The measures of quality are as proposed by Asness et al. (2019), profitability, growth, and safety. Asness et al. (2019) use the basic intuition behind the Gordon Growth Model to show how price-to-book ratios depend on these quality measures. The Gordon Growth Model can be used to determine the intrinsic value of a stock based on dividends and their future growth rate.

$$P = \frac{D}{r - g} \quad (4)$$

Equation (4) displays the general Gordon Growth Model, where P is the stock price, D is the dividend, r is the discount rate and g is the dividend growth rate. Dividing both sides of the equation by the book value of equity (B), we arrive at the following equation:

$$\frac{P}{B} = \frac{\left(\left(\frac{Profit}{B} \right) * \left(\frac{Dividend}{Profit} \right) \right)}{(Discount\ rate - Growth\ rate)} \quad (5)$$

From this equation, the following relationship evolves:

$$\frac{P}{B} = \frac{(Profitability * Payout\ Ratio)}{Discount\ Rate - Growth\ Rate} \quad (6)$$

Asness et al. (2019) argue that, according to Modigliani and Miller (1958), the payout ratio of a company does not affect the price of its shares since the economy we consider is frictionless. From equation (6), it can be inferred that a company with a higher profitability per book value (BV) should demand a higher price (holding all else equal). A company with a higher growth rate of profits should demand a higher price

(holding all else equal), and a company with a lower discount rate should also demand a higher price (holding all else equal). The definition of each measure will slightly deviate from the QMJ paper with the aim of additional or differing findings. In the following section, I will define the quality measures used for my research in greater detail.

3.3.1. The quality measures

To normalize the data, the logarithm of all measures is used for further analysis. Using log values helps in overcoming heteroscedasticity, making a non-linear relationship linear and brings a distribution that is positively skewed closer to a normal distribution (Brooks, 2014).

1) Profitability

Asness et al. (2019) measure profitability as an average score of return on assets (ROA), return on equity (ROE), gross profits over assets, cash flow over assets, gross margin, and cash earnings. In this research, profitability is measured as the average score of ROA and ROE. To calculate monthly log ROA, yearly income before extraordinary items (IB) and total assets (AT) are retrieved for every company and evenly spread over each month of the fiscal year. The formula used is as follows:

$$\text{Score } ROA_{i,t} = \frac{IB_{i,t}}{(AT_{i,t-1} + AT_{i,t})/2} \quad (7)$$

Where i is the respective firm and t the month. To calculate monthly log ROE, shareholder equity is retrieved. If not available it is approximated as total assets minus total liabilities and minority interests. Book equity (BE) is calculated as shareholder equity minus preferred stock value. All values are again evenly spread over the year. ROE was calculated as follows:

$$\text{Score } ROE_{i,t} = \frac{IB_{i,t}}{(BE_{i,t-1} + BE_{i,t})/2} \quad (8)$$

Within each country and each month, the measures are ranked relative to each other, assigning higher ranks to companies with higher ROA and ROE. Afterwards, I create an overall profitability measure by averaging the ROA and ROE ranks. If either one or both of the measures are missing, no score is assigned.

2) Growth

Asness et al. (2019) measure growth as the five-year growth in all profitability measures. This research follows their calculations, however, using one-year instead of five-year growth measure due to a shorter time period of the data used. First, the one-year growth rate of each of the profitability measures is calculated and then ranked according to the same procedure as used for the profitability measures.

$$\text{Score ROA Growth}_{i,t+1} = \left(\frac{\sum_{l=t-11}^t \text{ROA}_{i,l}}{\sum_{l=t-23}^{t-12} \text{ROA}_{i,l}} \right)^{-1} \quad (9)$$

$$\text{Score ROE Growth}_{i,t+1} = \left(\frac{\sum_{l=t-11}^t \text{ROE}_{i,l}}{\sum_{l=t-23}^{t-12} \text{ROE}_{i,l}} \right)^{-1} \quad (10)$$

The overall growth score is then, again, the average of both scores. If one of the scores is missing, no score is assigned.

3) Safety

Asness et al. (2019) measure safety using beta, the leverage ratio, the O- and Z-Score, and ROE volatility. In this research, safety will be measured in terms of beta and leverage ratio. To calculate market betas, the return index data from each country's main index (as displayed in Table 2) is downloaded and translated to Euros to serve as market return approximation. Since Compustat Global provides no total return measure, it is calculated as follows:

$$\text{Log Returns}_{i,t} = \text{LN} \left(\frac{\left(\left(\frac{P_{i,t}}{AF_{i,t}} \right) * \left(1 + \frac{TRF_{i,t}}{100} \right) \right)}{\left(\left(\frac{P_{i,t-1}}{AF_{i,t-1}} \right) * \left(1 + \frac{TRF_{i,t-1}}{100} \right) \right)} \right) \quad (11)$$

The total return factor (TRF) includes cash equivalent distributions, the reinvestments of dividends, and compounding effects paid on reinvested dividends. AF is the adjustment factor and P the monthly closing stock prices. TRF, AF, and P are translated to monthly measures since only daily data has been available. To translate the data, a VBA code is used, always using the last available stock price of each month as the end of the month price (same procedure with TRF and AF). Both, the index and the company stock returns are translated into log returns. Each company's 1-year beta score is then calculated as follows:

$$\begin{aligned}
\text{Score } \beta_{i,t+1} &= \frac{\text{Cov}(r_i, r_m)}{\text{Var}(r_m)} \\
&= \frac{\sum_{j=t-11}^t (r_{i,j} - \bar{r}_i)(r_{m,j} - \bar{r}_m)}{\sum_{j=t-11}^t (r_{m,j} - \bar{r}_m)^2}
\end{aligned} \tag{12}$$

To give a better score to low-beta companies, the data is now ranked in a descending manner to find the beta scores.

To calculate the leverage ratio, total liabilities (LT) for each company are retrieved and spread over the financial year, and the leverage ratio is then calculated as follows:

$$\text{Score } \text{Leverage}_{i,t} = \frac{LT_{i,t}}{AT_{i,t}} \tag{13}$$

Similar to the beta score, the data is now ranked in a descending manner to find the leverage score. Finally, both scores are averaged to find the overall safety score, and again, if there are one or two missing scores, the company receives no score for this month.

4) Overall quality score

To find the overall quality score, all sub-measures are combined into a single score by averaging. This average score is used as proxy for firm quality. If one of the scores is missing, no quality score is assigned.

3.3.2. Data analysis

The following paragraph will discuss all research questions and investigate them in further detail.

For this part of the thesis, the overall sample has been divided into developing and developed countries rather than each country separately. Consequently, the calculation of the quality measures has been rescored across the whole samples of all developing and all developed countries in the same way as explained above.

1) Do high-quality stocks across different countries demand higher prices?

As stated above, to answer the first research question, whether high-quality stocks demand higher prices, the following regression is used, where $P_{i,t} = \log(BM_{i,t})$, market-to-book is defined as the current market value of equity of the firm in year t divided by the company's book value. Prices are scaled by book values to make companies comparable. For better comparability of quality scores and the scaled prices, P is also translated into a relative score measure.

$$P_{i,t} = \alpha + \beta \text{Quality}_{i,t} + \mu_i + \varepsilon_{i,t} \quad (1)$$

The regression coefficient β measures the percentage increase in market-to-book associated to a one standard deviation increase in the quality score. μ measures the variables that affect P cross-sectionally but do not vary over time.

With this regression, I will test my Alternative Hypothesis that $\beta > 0$ against the Null Hypothesis that $\beta = 0$.

To examine the individual effect of each measure, the following regression has been added to the analysis:

$$P_{i,t} = \alpha + \beta_1 \text{Profitability}_{i,t} + \beta_2 \text{Growth}_{i,t} + \beta_3 \text{Safety}_{i,t} + \mu_i + \varepsilon_{i,t} \quad (14)$$

The regressions are Fama MacBeth regressions and are run year-by-year, using June observations. Due to the yearly frequency of the fundamental data, yearly rather than monthly frequencies were chosen for the regressions (this process also follows the analysis of Asness et al. (2019)). Country and industry fixed effects have been considered throughout the analysis to remove the impact of an omitted variable bias. All standard errors have been tested for the five classic linear regression model assumptions (see Matlab code 2 in the Appendix) and have been corrected for heteroscedasticity and autocorrelation of up to 12 lags using Newey and West (1987)'s heteroscedasticity and autocorrelation consistent standard errors (Matlab code 1).

2) Will QMS or any other quality-based strategy yield positive abnormal returns?

The second part of the thesis tests different trading strategies associated with the Quality Minus Junk theory. The first step is to construct 24 QMJ portfolios, one within each country. Therefore, 10 deciles are set up to rank the quality of the respective stocks. Then a zero-cost portfolio is constructed that invests long in the 10th decile (quality stocks) and short in the 1st decile (Junk stocks). Another strategy investigated in this research follows the strategy Asness et al. (2019) have used, namely investing long in the top 30 percent and short in the bottom 30 percent. Asness et al. (2019) have followed a strategy of investing in the top 1/3rd and shorting the bottom 1/3rd of the companies. Consequently, the strategy of investing long/short in the top/bottom 30% is quite related to their proposed strategy.

Both of the above-mentioned strategies have been conducted using an equally weighted and a value-weighted portfolio approach. Value-weighting strategies reduce

investor risk through lower weights towards risky small cap firms. However, it also reduces return due to the high growth rate among low-cap firms and potentially lower diversification and over-weighting towards mega companies (Forbes, 2016). All prominent market indices are value-weighted due to the overweighting of small-cap relative to large-cap stocks in equal-weighting approaches, which is why value-weighting is a more realistic approach. Asness et al. (2019) only follow a value-weighted approach in their research, however, I believe that it will add extra value to also examine equal-weighted portfolio constructions. Hou et al. (2017) show that many trading anomalies that have been found to be persistent when constructing equally-weighted portfolios disappear once the portfolios are value-weighted. Anomalies that are present in both equal- and value-weighting are therefore especially meaningful. To test whether the QMJ portfolios experience positive above market returns, I test the Alternative Hypothesis of $\alpha \neq 0$ against the Null Hypothesis of $\alpha = 0$. To do this, the following regressions is used:

$$rQMJ_t = a + \beta^{MKT-rf} MKT - rf_t + \varepsilon_t \quad (2)$$

$$rQMJ_t = a + \beta^{MKT-rf} MKT - rf_t + \beta^{SMB} SMB_t + \beta^{HML} HML_t + \beta^{UMD} UMD_t + \varepsilon_t \quad (3)$$

Again, all standard errors have been tested for the five classical linear regression model assumptions.

- 3) Is Momentum combination efficient in reducing risk through cross-country diversification effects compared to QMJ

For the second portfolio construction, I apply a momentum portfolio across all QMJ portfolios retrieved before. The number of quantiles in the portfolio calculation is now reduced since there are only 24 country portfolios left to distribute into those baskets.

Momentum is computed by summing the past t-2 to t-12 returns, leaving out the most recent month, which is a common practice to avoid microstructure distortions. This results in a shift of the starting year of our first data point 12 months back. In the next step I calculate three quantiles for the dataset, arriving at two thresholds per month. In the following step I assign the appropriate quantile to each momentum value. In the last step, the portfolios are built through averaging all returns within each quantile per month and then going long and short in the respective quantiles.

4. Results

The following paragraph will first discuss the findings with regard to the price of quality and then the results from all QMJ portfolios.

4.1. The price of quality

This section will discuss research question 1, whether higher-quality stocks demand higher prices than lower-quality stocks for the subsamples of developed and developing countries. The analysis is conducted as explained in section 3.3.2. Table 4 in the Appendix displays the Fama MacBeth regression results for the developed country sample and Table 5 indicates the results for the developing country sample. Quality is significant within the developed as well as the developing sample, however, coefficients, t-stats, and the adjusted R^2 are higher for the developing country sample. The beta for developed markets is around 0.20 (depending on the consideration of fixed effects) and around 0.25 (depending on the consideration of fixed effects) for developing countries. These findings imply that a one standard-deviation change in a company's quality score (cross-sectionally) will imply a 20% increase in the price-to-book ratio of developed countries and a 25% increase in the price-to-book ratio of developing countries. Asness et al. (2019) find a coefficient of 0.23 for the U.S. sample and 0.17 for the global sample, so the findings are in line considering the shorter time period and the simplified quality calculation of this research. The adjusted R^2 significantly increases with the consideration of fixed effects, however, the highest value is 26%. Asness et al. (2019) also find quite low R^2 throughout their sample, the highest value they find in the global sample is 43%, however, their analysis for this respective regression includes other controls, such as firm size, firms age, 1-year return, profit uncertainty and dividend payer. The adjusted R^2 including only fixed effects are in line with my findings.

Figure 2: The price of quality over time

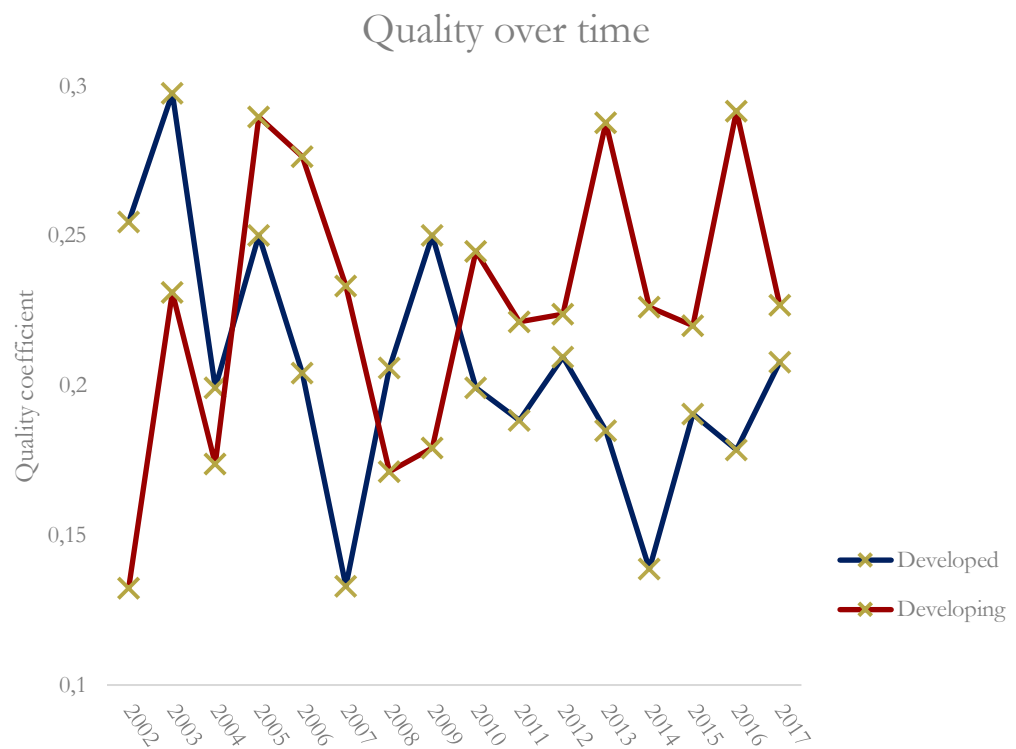


Figure 2 displays the variation of the price of quality over time, overall, quality is relatively volatile over time. When looking at the work of Asness et al. (2019), a drop during the internet bubble in 2000 can be observed. The figure above starts in 2002 and we can see the price of quality just recovering from the low of the bubble. We can see another low around the time of the financial crisis in 2009, and one during the Euro-deflation crisis in 2014 (many of the countries comprising the developed sample are European countries) (telegraph, 2014). Following those negative events, the price of quality increases drastically. The sample of the developing countries starts off following the developed country sample with a small lag, from about 2004 onwards, the developed country sample follows the developing country sample, which changes again in 2014. In 2017, the coefficients move in opposite directions. A reason for this behavior could be the appearance of several crises in developing countries around 2017, such as the escalation of the human crisis in Egypt (middleeastmonitor, 2017) or the increasing tensions between Mexico and the U.S. due to the Trump legislation (crisisgroup, 2017). This development of the price of quality can also be linked to the risk premia from the QMJ portfolio, which will be discussed in more detail in section 4.3.

Figure 3: T-stats per industry from the price on quality regressions

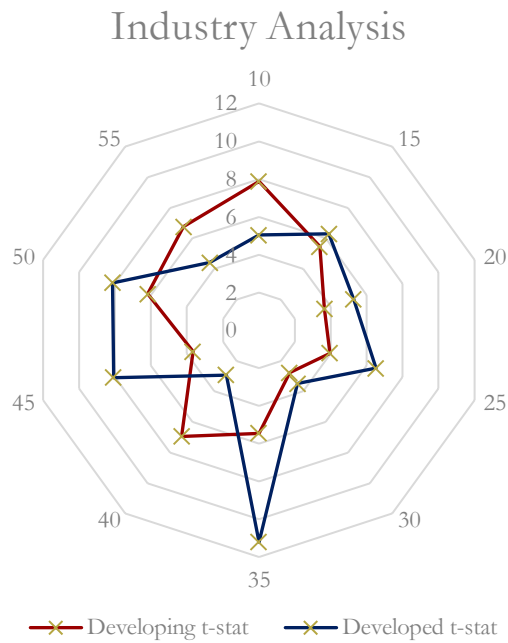


Figure 3 reports the annual Fama MacBeth t-statistics for each industry (as specified in Table 1) from the quality regressions including country and industry fixed effects. All industries are significant, and the price of quality is consistent throughout industries, further, the explanatory power of quality is not driven by one or a few specific industries. In line with Asness et al. (2019), the health care industry has one of the highest t-stats within the developed country sample. Within developed countries overall, the IT and the telecom are the next most pronounced industries, whereas the energy, utilities and finance sectors show the highest t-stats for the developing country sample. These results indicate the stronger shift towards more recent industries within developed countries, whereas the focus within developing countries is more bound towards traditional industries.

4.2. The price of quality sub-components

The quality sub-components are significant throughout the developed country sample, the growth measure is the most pronounced and the safety measure is the least pronounced within the developed country sample, which is in line with the findings from Asness et al. (2019). However, when analyzing the sub-factors for the developing sample, profitability and growth show signs of near multicollinearity and hence, have been kept merged as one score and only safety has been split apart. The measure of profitability and growth is highly significant with a large coefficient throughout the developing country sample. Another interesting finding within the developing country

sample is that the safety measure is significantly negative associated with the scaled prices. This indicates that, for developing countries, a one standard deviation change in a stocks safety score is associated with a 10% decrease in its book-to-market ratio, implicating that investors will want to pay less for a safer stock within developing countries. The safety measure is already the least pronounced across the developed market sample as well as throughout the samples of Asness et al. (2019)'s research. A possible explanation for this finding is that riskier stocks are associated with higher returns. Since emerging markets are, on average, associated with higher volatility, investors engaging in developing markets securities are more tilted towards a higher risk-loving nature than the average investor. These investor characteristics could implicate that emerging markets investors are not willing to pay a higher price for low-risk stocks. The finding above has led me to not only to investigate the QMJ portfolio returns for the portfolio constructed as suggested by Asness et al. (2019), but also to reverse the safety score for the developing country portfolios and allocate higher scores to more risky companies. The comparison of the general QMJ portfolios and the high volatility QMJ portfolios for developing countries will be further discussed in section 4.6.

4.3. Quality minus Junk portfolios

This section discusses the quality based long/short portfolio outcomes, Tables 6 – 13 report the regression results and summary statistics for all portfolios.

In general, the portfolios going long in the top and short in the bottom decile show a higher frequency of insignificant values and larger tail risks as compared to the portfolios going long and short in the top and bottom three deciles. Furthermore, the 30/30 long/short portfolios show negative correlations to the market, the size, and the value factors, whereas the 10/10 long/short portfolios have less pronounced negative factor loadings as displayed in Figure 4. Developed markets have, on average, a more pronounced negative factor loading towards the market factor (-1.02 for the equally-weighted portfolios and -0.87 for the value-weighted portfolios) when compared to developing markets (-0.67 for the equally-weighted portfolios and -0.64 for the value-weighted portfolios). The factor loadings towards value and size are similar amongst developing and developed countries and average between -0.80 and -0.11.

Due to the overall bad and insignificant performance of the 10% portfolios, they are no longer considered throughout the rest of this thesis, however, all regression outcomes can be found in the Appendix.

Figure 4: QMJ factor loadings

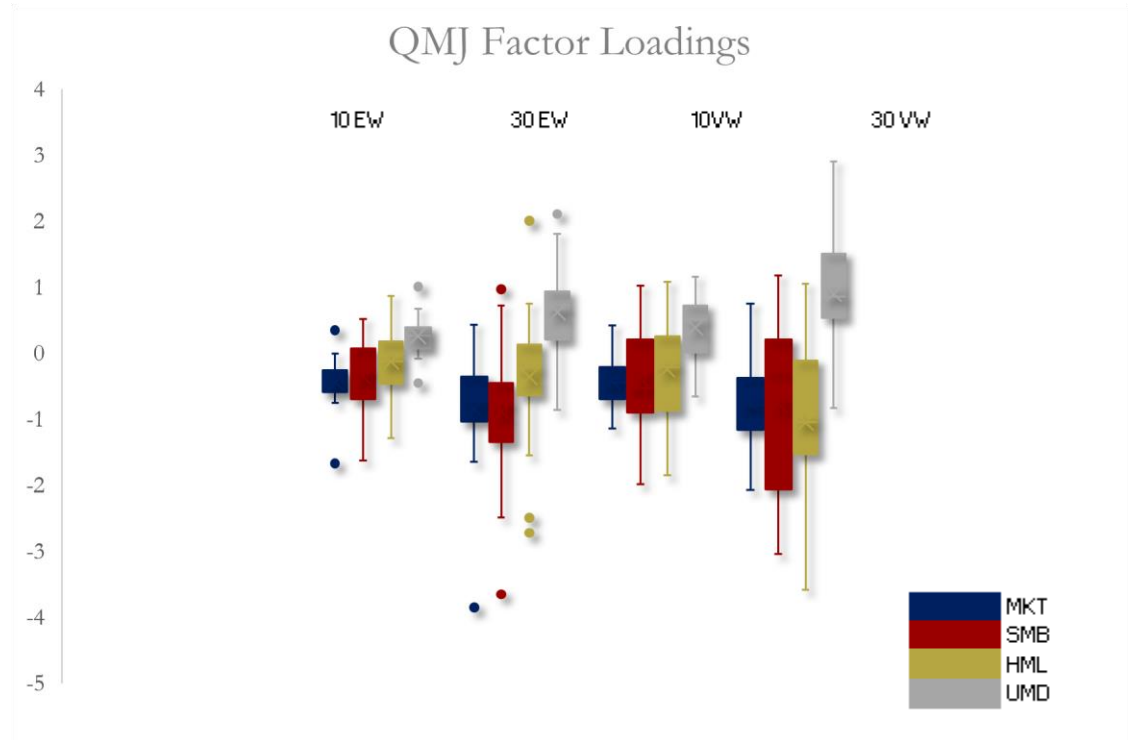


Figure 4 and 5 display the value-weighted and equally weighted QMJ alphas for the 30/30 portfolios. In general, value-weighted portfolios are found to have higher alpha values, however, the developing portfolio sample shows no clear distinction as to which strategy yields higher alpha values. The worse performance of the equally weighted portfolios within developing markets can be explained by the fact that overweighting towards risky small-cap stocks is subject to more volatility within these countries as smaller companies might be even more vulnerable than in developed markets. Furthermore, alphas in developing countries are, on average, slightly higher than for developed countries, the equal-weighted portfolios yield is 0.49 and 0.45 (on average) respectively and the value-weighted portfolios average is 0.54 and 0.52 respectively. All portfolio alphas except the value-weighted New Zealand CAPM alpha (consistent with Asness et al. (2019)) are significant at a 5% level. The countries yielding the highest value-weighted alphas are Malaysia (0.98), Poland (0.88), and Norway (0.82). The highest equally weighted alphas are found in Brazil (0.87), Egypt (0.82), and Australia (0.77).

Figure 5: EW/VW QMJ alphas

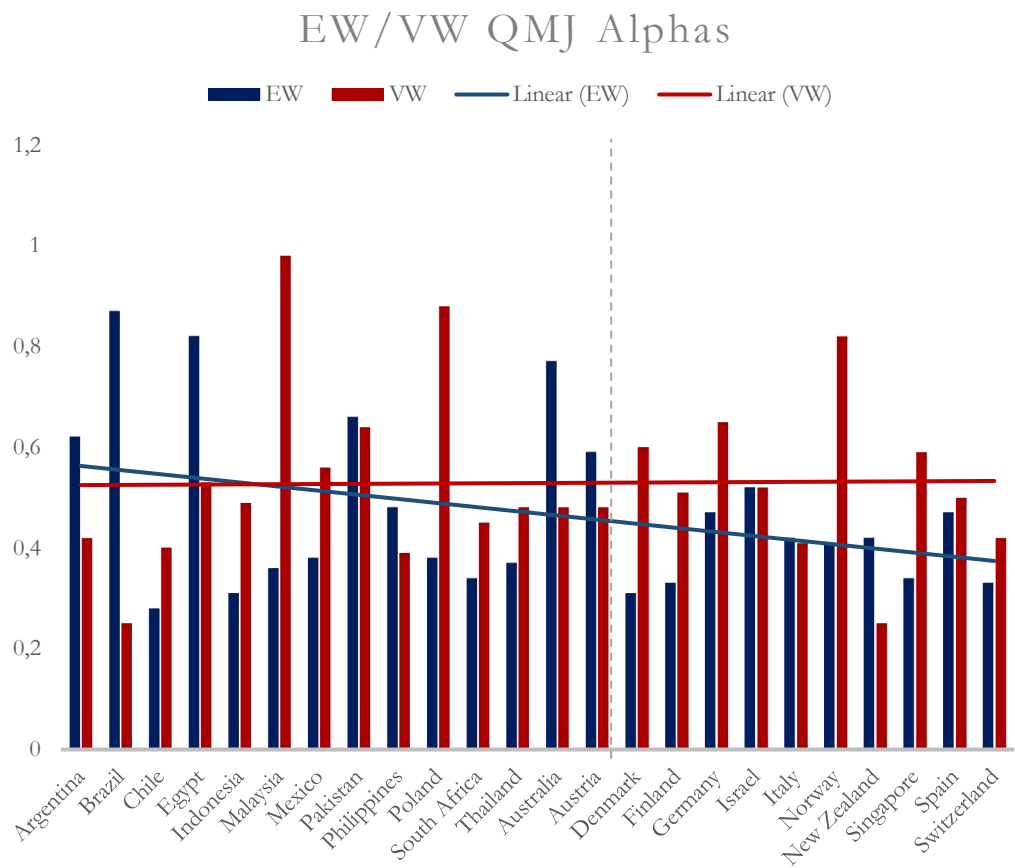
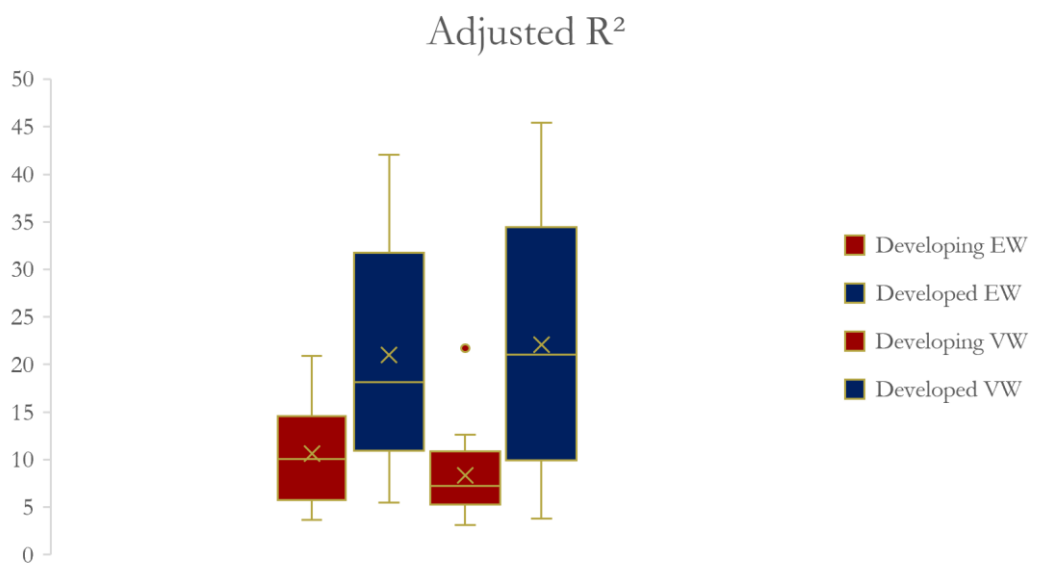


Figure 6 displays the adjusted R^2 values for the different portfolio constructions, R^2 is in general much larger in developed markets, when compared to developing markets.

Figure 6: R^2 values for QMJ portfolios



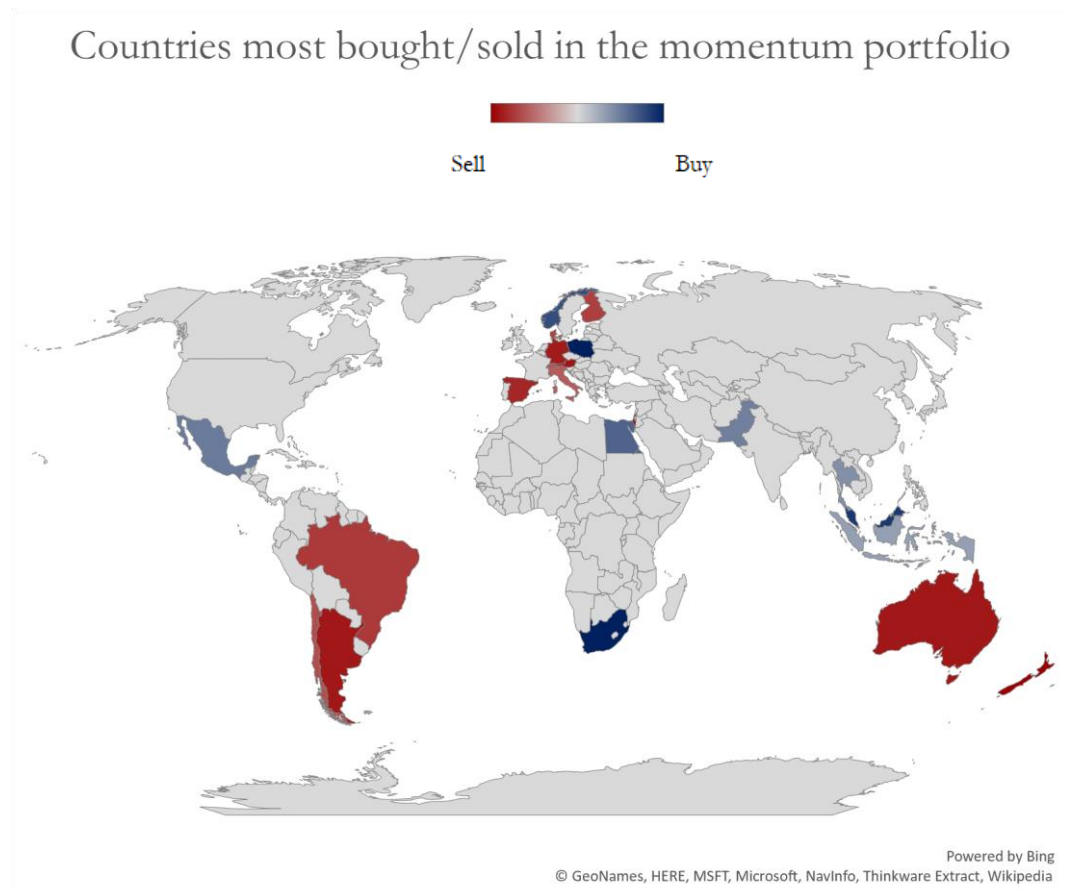
4.4. The Momentum Portfolio

This section will discuss the results from the momentum construction, using the 30% value-weighted QMJ portfolios. Table 14 in the Appendix displays all regression outcomes and summary statistics (UMD is ignored in the regression analysis as the portfolio constructed already represents the momentum factor).

When investing in all QMJ portfolios, the strategy would yield a Sharpe Ratio of 1.73 and a three-factor alpha of 1.53, however, the strategy is also subject to large tail risks, which can be observed in the high value for excess kurtosis (3.13) and the high minimum value of -9.16. The long/short momentum portfolio produces a Sharpe Ratio of 0.68 and a three-factor alpha of 0.33, nevertheless, momentum is efficient in reducing excess kurtosis to 0.81 and the minimum value to -3.99. When examining the performance of both strategies, there seems to be a large trade-off between risk-adjusted returns and tail risks, however, I find one strategy that seems to optimize this trade-off. A long only momentum strategy yields a Sharpe Ratio of 1.52, an alpha of 0.71, an excess kurtosis of 1.52 and a minimum value of even slightly less than the long/short strategy (-3.78). With regard to the factor loadings, the strategy going long in all portfolios has large negative factor loadings and the long only strategy somewhat loses the strength of negativity, however, the values are still significantly negative. Another argument in favor of the long only strategy when compared to investing in all portfolios are lower transaction costs due to larger investments in each single portfolio.

Figure 7 displays the countries that are most often shorted (red) and bought (blue) when constructing the momentum portfolio. The darker coloring indicates the higher frequency of buy/sell decisions. In general, developing countries are rather buy countries and developed countries are rather sold countries. This fact confirms the findings throughout this thesis, suggesting that the quality factor is more pronounced in developing countries. The most bought countries in the sample are South Africa and Poland, the country most sold is New Zealand.

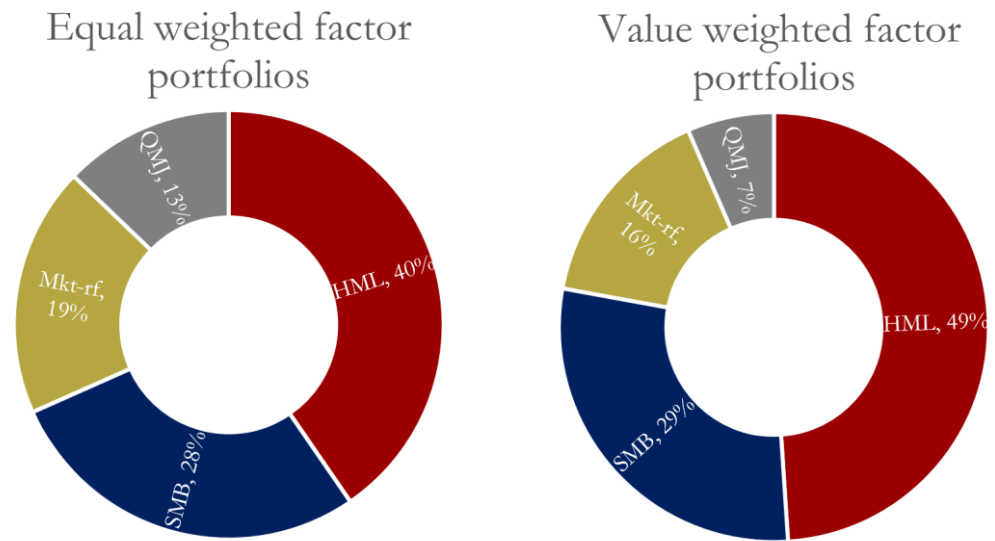
Figure 7: Countries most bought/sold in the momentum portfolio



4.5. Factor combo portfolios

Tables 15 to 22 report the summary statistics for the portfolios discussed in this section. Due to the negative correlation with the three Fama & French factors, this paragraph discusses several combinations of the QMJ portfolios developed above and the Fama & French factors. Each, the value-weighted and the equally weighted QMJ portfolios have been combined with all Fama & French factor separately, the weights towards each factor are 50% respectively in these portfolios. Furthermore, I have constructed a portfolio, combining all four factors, the weights towards each factor have been chosen by maximizing the overall Sharpe Ratios using Excel Solver. This portfolio will be referred to as rainbow portfolio in the following. The weights distributed towards each factor are displayed in Figure 8.

Figure 8: Weights towards each factor in the rainbow portfolios



There are no alphas displayed for those portfolios. This is due to the fact that the independent variables are also part of the dependent variable of each portfolio, which distorts the alpha values and the interpretation would lose validity. The Sharpe Ratios of the combo portfolios are overall higher than the general QMJ portfolio Sharpe Ratios (Figures 9 and 10). The rainbow portfolios find the highest Sharpe Ratios (averaging 2.18 for equal-weighting and 1.44 for value-weighting), followed by the market combo portfolio (averaging 1.93 for equal-weighting and 1.04 for value-weighting). Further, the rainbow portfolio is also the most efficient in reducing tail risks, average excess kurtosis is reduced from 6.45 (general QMJ portfolios) to 2.31 for the equal-weighted portfolios and from 6.00 to 2.46 for the value-weighted portfolios. To conclude, each factor combo portfolio reduces tail risks and improves risk-adjusted performance of the portfolios, if only one factor should be chosen to be combined with QMJ, the market factor combo results in the biggest portfolio improvements. However, a combination of all factors with the quality factor will yield the best portfolio characteristics and also outperforms the long only momentum portfolio. Nonetheless, the argument concerning transaction costs arises again, as already mentioned above the long only momentum is more efficient in this issue.

Figure 9: Sharpe Ratios for the equal-weighted factor portfolios

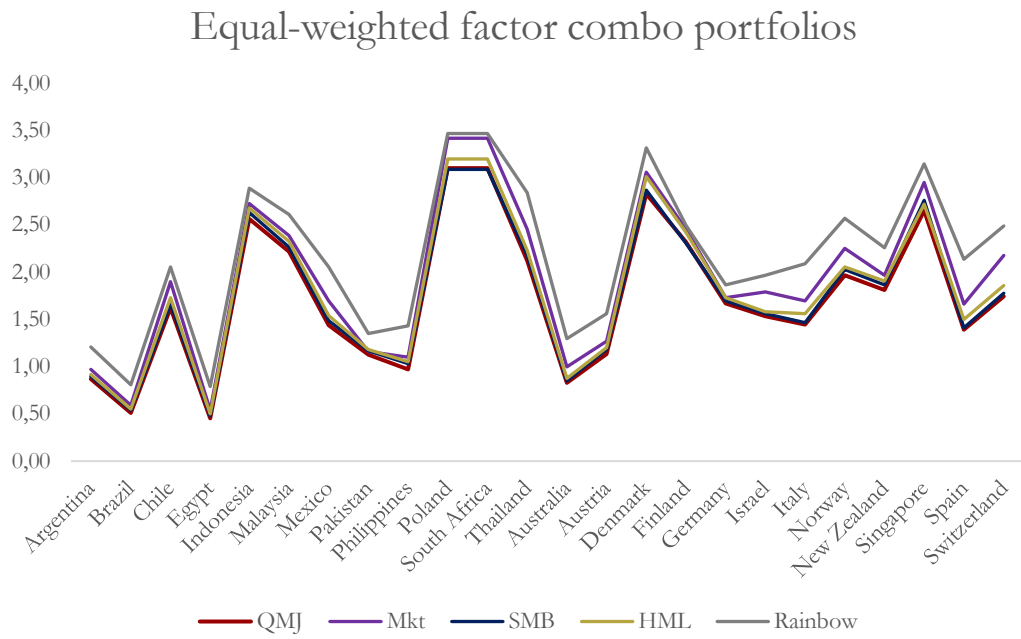
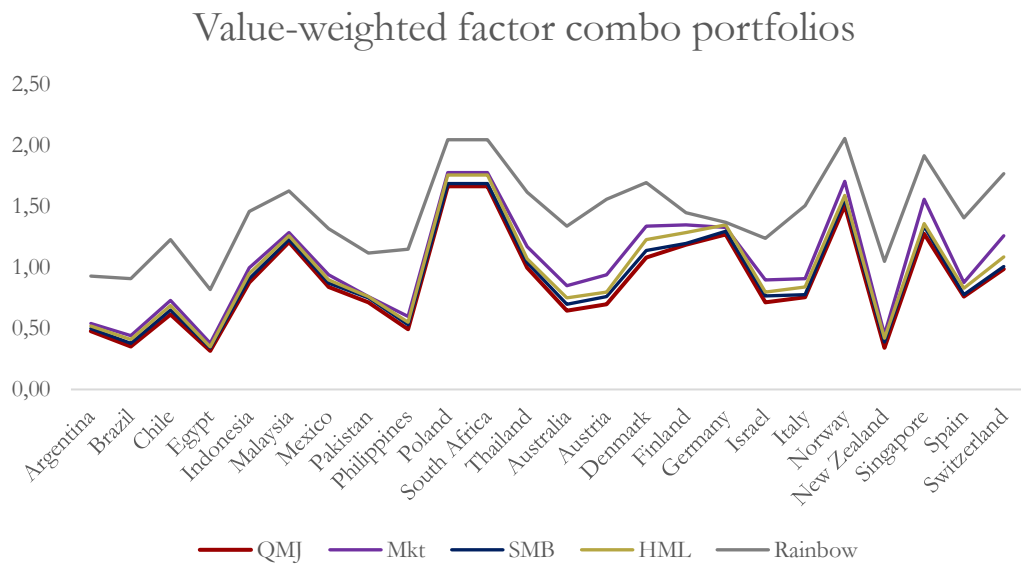


Figure 10: Sharpe Ratios for the value-weighted factor portfolios

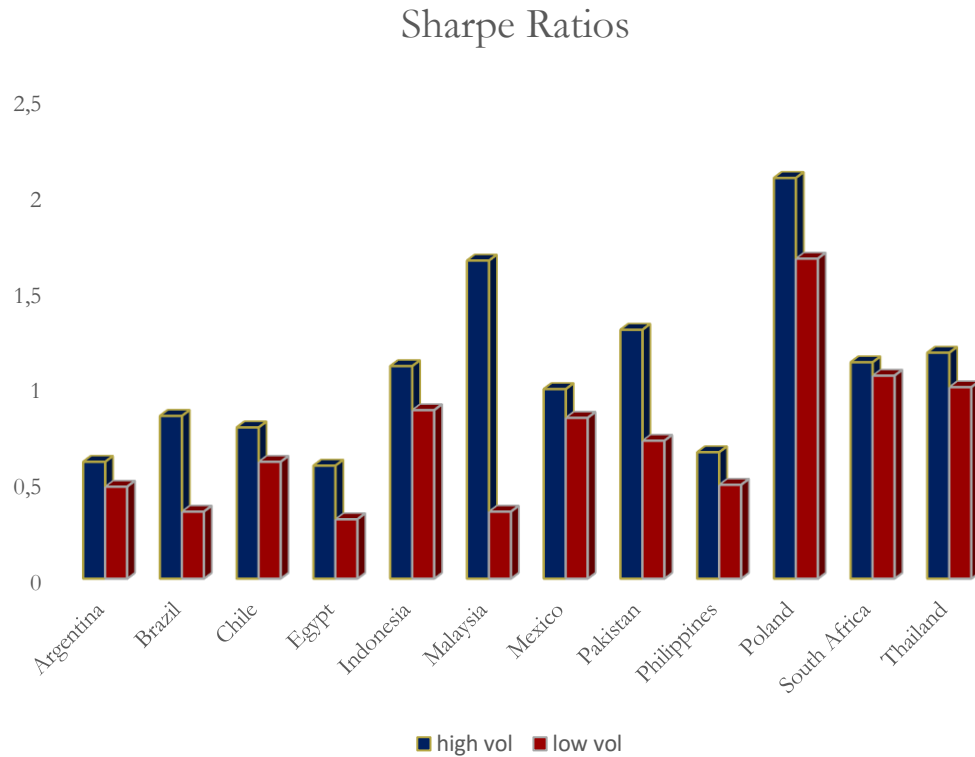


4.6. High-volatility and high-quality trading strategy in emerging markets

Due to the negative relationship of the safety factor with the scaled prices in the emerging country sample (as mentioned in paragraph 4.2), I decided to construct a high-volatility, high-quality strategy. The only deviation from the common QMJ portfolios made to construct the portfolios was to reverse the ranking for the safety factor. The safety measure was changed in a way that companies with high risk measures were allocated higher scores. This strategy is intuitive since it is consistent

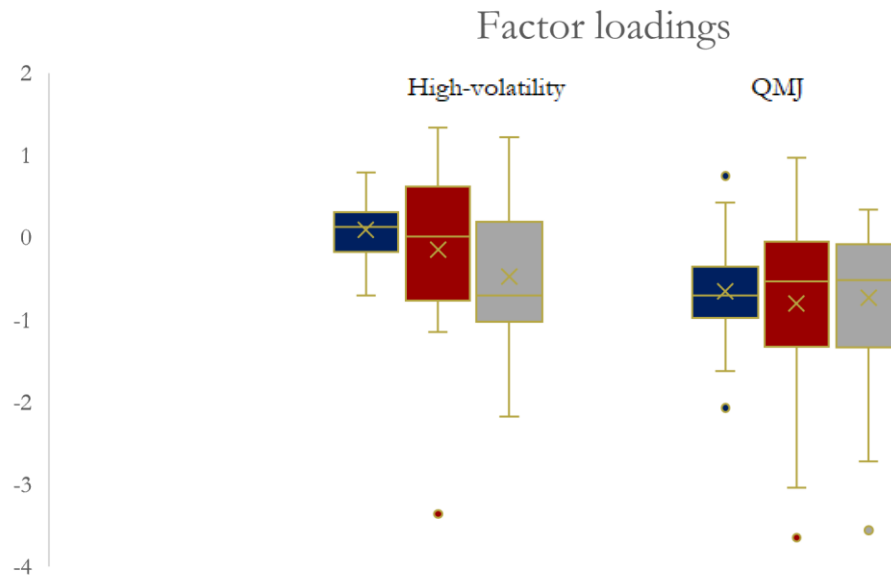
with common finance theory i.e. the risk-return trade-off, riskier stocks should be rewarded with higher returns. In fact, the high-volatility strategy achieves higher Sharpe Ratios (and alphas) throughout the emerging country sample (Figure 11).

Figure 11: Sharpe Ratios high-volatility strategy



However, the high performance of this strategy does not come without a trade-off. Reversing the safety measure largely reduces the negative factor loading of the strategy, which can be seen in Figure 12. This finding suggests that the safety measure is the major driver of the negative factor loadings of the QMJ portfolios. A possible explanation for this might be that the other factors persist due to additional risks, not accounted for by asset pricing models. Hence, including measures of safety counterbalance those unaccounted risks and create a negative correlation towards the factors. To conclude, even though the portfolio above yields alphas and Sharpe Ratios well above the common QMJ portfolios, the compromise with regards to the factor loadings should be taken into consideration.

Figure 12: Factor loading high-volatility vs. QMJ

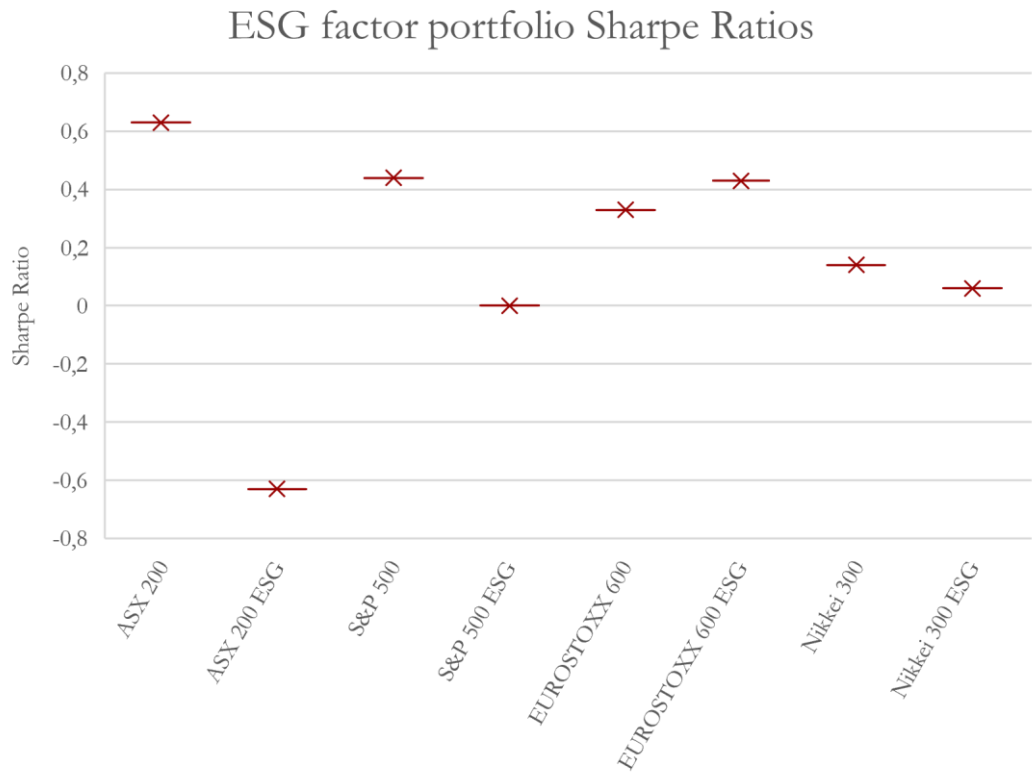


4.7. The ESG factor as an additional quality sub-component

Due to a rather scarce availability of ESG scores, it was not possible to find scores for all companies included in the QMJ portfolios. As a consequence, pure ESG portfolios were constructed only using companies that comprise large enough indices. The indices chosen largely to represent the universe of developing markets (S&P 500, EUROSTOXX 600, Nikkei 300, ASX 200), however, no index with sufficient ESG scoring for developing countries was found. The data was again divided into three baskets according to ESG scores.

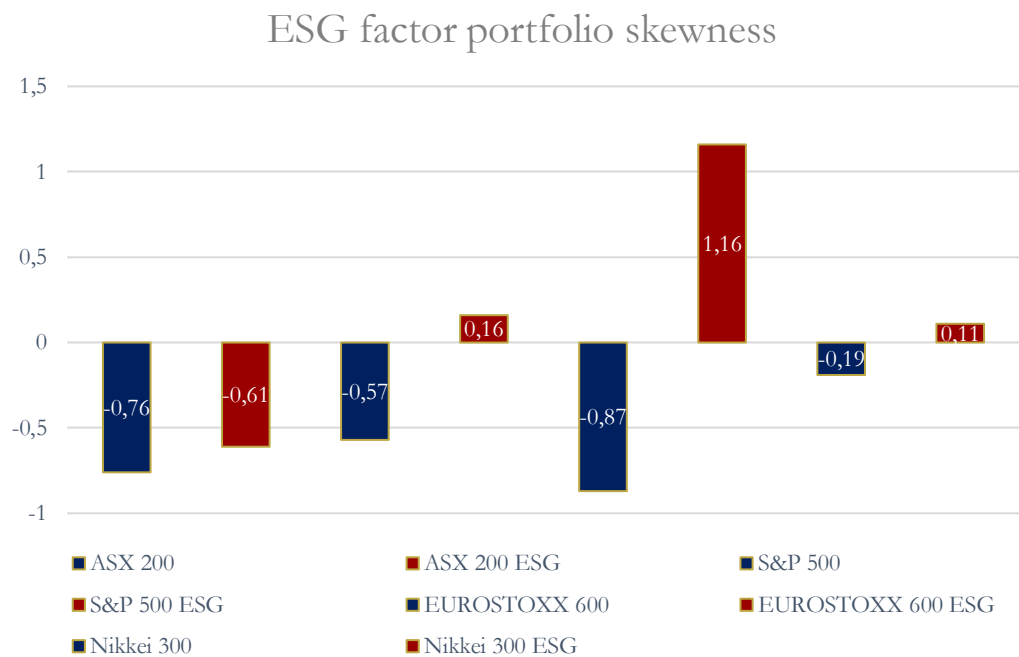
Figure 13 displays the Sharpe Ratios for the ESG factor portfolios going long in the top 1/3 of companies and short in the bottom 1/3. The findings regarding the factor portfolios vary substantially across regions, while the European ESG portfolio outperforms the respective index, the Japanese ESG portfolio performs slightly worse than the index and the Australian, as well as the U.S. ESG portfolios underperform the index.

Figure 13: ESG factor portfolio Sharpe Ratios



The minimum values for the ESG portfolios are substantially smaller than those of the respective indices, ESG portfolio performance in terms of excess kurtosis varies across regions. However, a common finding across all regions is the improvement of portfolio skewness as reported in figure 14.

Figure 14: ESG factor portfolio skewness



To sum up, due to the differing findings, no clear conclusion can be inferred from the above analysis, however, it becomes clear that including ESG factors improves portfolio skewness, as well as the severity of minimum values. While in most regions tested, this improvement comes with lower risk-adjusted returns, this trade-off is not true for Europe, where risk-adjusted returns improve.

5. Conclusion and outlook

This paragraph will conclude the major findings of this work and discuss potential implications.

Should investors be willing to pay a higher price for companies that are subject to higher profitability, growth, and safety? The short answer to this question is yes, quality is efficient in explaining scaled prices within developing and developed markets, coefficients, t-stats, and the adjusted R^2 are higher for the developing country sample. The developed country beta for developed markets is around 0.20 (depending on the consideration of fixed effects) and around 0.25 (depending on the consideration of fixed effects) for developing countries. The price of quality is very volatile and experiences low values during crisis periods, which are followed by sharp hikes. In more recent years, the behavior of the price of quality in developing and developed markets deviates due to crisis situations that are uncommon between those regions.

However, the answer to the question above experiences a twist when examining emerging markets, the quality sub-factors are all efficient to explain variations in prices within developed markets, but only growth and profitability are significant and positive within developing markets. One interesting finding of this study is the negative significance of the safety factor within developing markets. In the case of developing countries, a one standard deviation change in a stocks safety score is associated with a 10% decrease in its book-to-market ratio, implicating that investors will want to pay less for a safer stock within developing countries. This result might seem puzzling at first, however, it allows for an interesting insight regarding the investment decision of emerging market investors. Due to the higher risk of emerging market stocks, investors expect large returns and the fact that emerging markets investors are not willing to pay a higher price for low-risk stocks leads us to the conclusion that investors engaging in these markets are more prone to take risks when compared developed market investors.

Furthermore, the results from this research propose that markets are not completely efficient and that strategies with positive alphas can be developed. Quality seems to be a strong driver of returns and it is even more pronounced in developing countries. QMJ alphas in developing countries are, on average, slightly higher than for developed countries, the equally weighted portfolios yield 0.49 and 0.45 (on average) respectively and the value-weighted portfolios average 0.54 and 0.52 respectively. However, one major question regarding the quality factor has not yet been addressed, which is whether the above-market returns of this strategy will persist in the future. The exceptional performance of factors must be explainable by either of these major attributes: additional risk or market inefficiency. If market inefficiency was the driver of quality-based returns, the alphas resulting from this strategy would not persist in the long-run and disappear after the information about this strategy becomes public. Due to the recency of the research on the quality factor, there have not yet been any long-term studies regarding its persistence. On the other hand, should additional risk be the major driver of the quality factor, the above-market returns will persist in the long-run. Since the volatility level of this strategy does not speak in favor of this claim, we have to focus on tail risks in order to build a strong risk story for this factor strategy. Similar to the momentum factor, QMJ is occupied with large tail risks which is due to possible sudden crashes in the returns of high-quality stocks and high growth in junk stocks. Another reason for this development is the monthly rebalancing of portfolios based on yearly financial data, even though the companies might experience large crashes during the year, their quality score is held constant until the next financial data publication. However, my research shows that the combination of QMJ portfolios with other factors is very efficient in reducing tail risks and improving risk-adjusted measures. To conclude this discussion, even though the persistence of this factor has not yet been researched, I believe that quality has a strong risk story and that the factor will persist in the long-run.

If one believes in the persistence of the quality factor, the next logical step is trying to overcome its major drawback, namely tail risk. In order to address this issue, I have constructed alternative factor portfolios, which are efficient in reducing QMJ's tail risks. The first portfolio construction involved a cross-country momentum strategy, using the QMJ portfolios as initial dataset. The long/short momentum strategy greatly reduces tail risk, however, also loses large parts of risk-adjusted returns. To overcome this problem, a long only momentum strategy has been constructed. This strategy yields a Sharpe Ratio of 1.52 (1.73), an alpha of 0.71 (1.53) and an excess kurtosis of

1.52 (3.13), the values in brackets represent an investment strategy going long in all QMJ portfolios.

Next, I built portfolios combining QMJ with the three Fama & French factors, these strategies are based on the ground of a negative correlation between these factors and quality. Each factor combo portfolio reduces tail risks and improves risk-adjusted performance of the portfolios. If only one factor should be chosen to be combined with QMJ, the market factor combo results in the strongest portfolio improvements. However, a combination of all factors with the quality factor will yield the best portfolio characteristics and outperforms the long only momentum portfolio (Sharpe Ratios average 2.18 for equal-weighting and 1.44 for value-weighting). Average excess kurtosis is reduced from 6.45 (general QMJ portfolios) to 2.31 for the equal-weighted portfolios and from 6.00 to 2.46 for the value-weighted portfolios.

Another portfolio construction built on the finding that the safety factor has a negative correlation with prices for the developing country sample. The high volatility strategy achieves higher Sharpe Ratios (and alphas) throughout the whole emerging country sample. However, the high performance of this strategy does not come without a trade-off. Reversing the safety measure largely reduces the negative factor loading of the strategy, which might implicate that the inclusion of a safety measure counterbalance extra risks taken by the other factors and creates a negative correlation towards these factors.

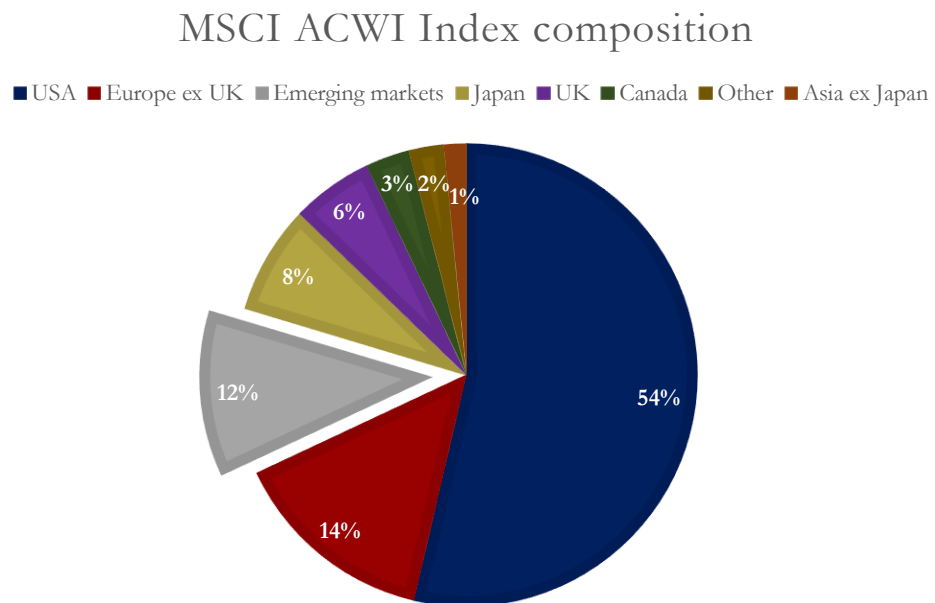
Lastly, I build factor portfolios using a company's ESG rankings, to determine whether the inclusion of a company's ESG performance as a fourth definition of quality could help in reducing tail risks of the quality factor. While considering ESG performance does reduce tail risks, it reduces risk adjusted returns in all regions except Europe, however, the portfolios built in this research are pure ESG portfolios and the severity of Sharpe Ratio reduction could be less dramatic when considering ESG not as a sole factor, but rather as one of the definitions of quality.

Bringing it all together, QMJ is a highly efficient factor in terms of positive alpha performance, as well as risk-adjusted performance and seems to be a persistent driver of returns. Quality portfolios perform even better in developing markets than in developed markets and are subject to significantly negative factor loading towards the market, value, and size. The strongest drawback of quality is its large tail risk; however, this study has found several alternative quality strategies which are efficient in overcoming this problem. Hence, quality-based investing is a promising strategy that

active investors should consider when building their portfolio strategies. Nonetheless, as there are already successfully implemented factor ETF's (such as momentum ETF's, value, or size ETF's) trading on the market, quality-based factor ETF's will possibly also enable passive investors to profit from this novel strategy in the near future.

Finally, in proofing that the quality factor is present and highly significant within developing markets, this work also proposes that more research needs to be conducted in developing markets as they are a major part of our economy and have been rather neglected in past studies due to their unpredictable behavior when compared to developed markets. Especially the finding of the negative safety factor proves that investing in emerging markets is still seen as a task for experienced and risk-loving investors even though the world portfolio proposes an investment of around 12% (Figure 13) towards developing markets (MSCI, 2019). Since the world portfolio is, according to general portfolio theory, the most diversified portfolio one can hold, every investor should hold the world portfolio and hence, a consideration of emerging markets should be out of question.

Figure 15: MSCI ACWI Index composition



6. Limitations

Although this study has delivered some new findings, its design is not without flaws. A number of caveats need to be noted regarding this work.

The main limitations are expressed as follows: to provide a more accurate decision about the quality factor in emerging markets, all MSCI World Developing markets countries should have been included in this research, however, the countries chosen broadly resemble the regions and states of development that contribute to the overall index. Second, the quality of emerging markets data is still somewhat less accurate, the data is less broadly available and is subject to a higher frequency of missing values. Further, the strategy did not take transaction costs into consideration, which are a crucial issue when dealing with factor strategies. Another drawback is that the momentum strategy is based on monthly rebalancing throughout markets located in different time zones and hence, different trading hours, which makes simultaneous trading impossible. Furthermore, the only measure accounting for the use of different currencies in the countries of my sample is the translation to a common currency measure, however, currency risk is still a major drawback of the above strategies. Further, the availability of fundamental data in a higher than yearly frequency would improve the accuracy of the models since the strategies mentioned above are based on monthly rebalancing.

Lastly, due to the recency of ESG measurement, the scores are not vastly available and hence, the ESG portfolios constructed for this thesis are restricted on large indices. Building factor portfolios, using indices rather than the whole universe of stocks available in one country gives rise to survivorship bias and the sample does not fully represent a regions stock market. Further, due to the bad availability of these scores, it was not possible to retrieve ESG data for all stocks in the sample and add the ESG score as an additional quality measure to accurately research its impact on quality portfolios. As a result, the pure ESG factor portfolios can only be used as an inference of how the inclusion of ESG decisions would affect quality portfolios. Additionally, the availability of ESG scores is even less vastly available within emerging markets, since it was not possible to find an index with a sufficient amount of ESG-scored companies, they have been ignored for this part of my research.

One could argue that the deviation from the quality measure Asness et al. (2019) use in their research might be drawback of this work. However, since the results found in this research yield similar results as Asness et al., I believe it should rather be

recognized as a new finding proposing that a simplified quality measure achieves comparably good results, while using a more time efficient calculation method.

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List of abbreviations

| | |
|------|--|
| AF | Adjustment factor |
| AT | Total assets |
| BE | Book equity |
| BV | Book value |
| CAPM | Capital Asset Pricing Model |
| CLRM | Classical linear regression model |
| ESG | Environmental, Social and Governance. |
| GIC | Global Industry Classification Standard |
| HML | High minus Low |
| IB | Yearly income before extraordinary items |
| LT | Total liabilities |
| P | Stock price |
| OLS | Ordinary least square |
| QMJ | Quality minus Junk |
| ROA | Return on Assets |
| ROE | Return on Equity |
| SMB | Small minus Big |
| TRF | Total return factor |
| UMD | Up minus Down |

8. Appendix

Table 2: General information for each country in the sample

This table displays all countries that have been used for the research, sorted by their stage of economy. The main index of each country as displayed in the table has been used to calculate the stock betas for the safety measure. The number of stocks is the total number used for the analysis after cleaning out companies with missing data.

| COUNTRY | REGION | MAIN INDEX | # OF STOCKS | STAGE OF ECONOMY |
|---------------------|------------------------|----------------|---------------|------------------|
| Argentina | South America | MERVAL | 91 | Developing |
| Brazil | South America | Bovespa | 1,041 | Developing |
| Chile | South America | IPSA | 238 | Developing |
| Egypt | North Africa | EGX 30 | 209 | Developing |
| Indonesia | Southeast Asia | JCI | 611 | Developing |
| Malaysia | Southeast Asia | FTSE Bursa | 1,278 | Developing |
| Mexico | North America | S&P BMV | 180 | Developing |
| Pakistan | South Asia | KSE 100 | 466 | Developing |
| Philippines | Southeast Asia | PSEi | 291 | Developing |
| Poland | Central Eastern Europe | WIG20 | 920 | Developing |
| South Africa | South Africa | JSE Top 40 | 523 | Developing |
| Thailand | Southeast Asia | SET50 | 817 | Developing |
| Total | N/A | N/A | 6,665 | N/A |
| Australia | Australia and Oceania | ASX200 | 2,189 | Developed |
| Austria | West Europe | AMEX | 137 | Developed |
| Denmark | North Europe | KFX | 299 | Developed |
| Finland | North Europe | OMXH25 | 217 | Developed |
| Germany | West Europe | DAX30 | 1,321 | Developed |
| Israel | West Asia | TA-100 | 550 | Developed |
| Italy | South Europe | FTSE MIB | 464 | Developed |
| Norway | North Europe | OSEAX | 249 | Developed |
| New Zealand | Australia and Oceania | NZX 50 | 244 | Developed |
| Singapore | Southeast Asia | MSCI Singapore | 908 | Developed |
| Spain | South Europe | IBEX 35 | 264 | Developed |
| Switzerland | West Europe | SMI | 394 | Developed |
| Total | N/A | N/A | 7,236 | N/A |
| Total | N/A | N/A | 13,901 | N/A |

Table 3: Rationale for the country selection

This table presents the rationale for the selection of each country. This table was added since it was an important factor to select countries from diverse regions and states of development to ensure a most accurate picture of the whole universe of developing and developed countries.

| COUNTRY | RATIONALE TO BE CHOSEN FOR THE STUDY |
|---------------------|---|
| ARGENTINA | Third largest economy of Latin America (in terms of GDP), member of G-20 major economies. The growing economy has been altered with severe recessions and income maldistribution. The country came back to world capital markets in 2016 after 15 years of exclusion. |
| BRAZIL | World's eighth-largest economy and one of the fastest growing major economies. However, the country is currently facing a political corruption scandal and nationwide protests (reasons for the market cap of the stock exchange to shrink over the last years). |
| CHILE | Most secure and productive economy in South America. Most competitive economy in South America. World's leading copper producer. |
| EGYPT | Economy currently in a restructuring process. Economy is mainly focused on tourism and manufacturing. |
| INDONESIA | Major exporter of oil and gas. One of the world's biggest supplier of coffee, cocoa and palm oil. |
| MALAYSIA | Third largest economy in Southeast Asia. One of the strongest economies in Southeast Asia. |
| MEXICO | Mexico's GDP growth and standard of living has slowed down in the past years and it is largely dependent on exports, which might make it an interesting target for short selling. |
| PAKISTAN | Pakistan's economy is currently at the brink of a major collapse due to inflation, a large deficit, a crisis situation with India and the countries indebtedness to China. |
| PHILIPPINES | Third largest economy in the ASEAN. One of Asia's fastest growing economies. Sixth richest country in Asia. |
| POLAND | Poland is a developed market and regional power as well as a possible emerging world power (one of the most dynamic economies in the EU). Warsaw Stock Exchange is the largest and most important in Central Europe. |
| SOUTH AFRICA | The largest country in Africa and the second largest economy on the continent. Johannesburg Stock Exchange is the oldest existing and largest stock exchange in Africa. |
| THAILAND | Thailand has evolved from a low-income economy to an upper-income economy within less than one generation. The Thai Baht is one of the most frequently used currencies in the world. Second largest economy in Southeast Asia. |

| | |
|--------------------|--|
| AUSTRALIA | World's 13th largest economy, with the second highest human development index globally, the country ranks highly in quality of life, health, education, economic freedom and civil and political rights. Stock exchange in the top 15 worldwide. |
| AUSTRIA | Measured in GDP, Austria is one of the richest countries worldwide. Austria also has one of the richest and most stable economies of the EU states, its economy is very liberal and socially focused. |
| DENMARK | Denmark's GDP is one of the highest in the world. Denmark is the home of some of the world-leading firms in the renewable energy and high-tech agriculture sector. |
| FINLAND | Finland's economy is highly industrialized, it's high-tech manufacturing sector is ranked second worldwide. |
| GERMANY | The most populous country in the EU, world's fourth largest economy as well as third-largest exporter of goods. Perceived as a great power, the country is a member of G7. Stock Exchange, Deutsche Boerse, is the 12th largest exchange in the world. |
| ISRAEL | Israel is amongst the 20 most advanced and developed countries in the world and has a higher standard of living than a lot of other Western countries. Israel has the second highest number of start-up companies worldwide and is the country with the third highest number of NASDAQ listed companies. Israel is also amongst the then happiest countries in the world. |
| ITALY | Origin country of the banking system, having a long tradition of financial services. The country has the eighth largest economy in the world and is ranked third for its central bank gold reserve. Perceived as both regional and global great power. |
| NORWAY | The country of Norway is very rich of natural resources, such as, oil, gas, minerals and forests. Norway is also one of the world's leading producer and exporter of seafood and fish. |
| NEW ZEALAND | New Zealand has the third highest economic freedom index worldwide and is one of the most globalized economies, highly depending on foreign trade. |
| SINGAPORE | Singapore is a global commerce, finance and transport hub. Third-largest foreign exchange market, third-largest financial center, third-largest oil refining and trading center and the second-busiest container port. The country has also been identified as a tax haven. The nation developed rapidly as an Asian Tiger economy, based on external trade and its workforce. |
| SPAIN | 14th largest economy in the world. Following the financial crisis of 2007/08, the Spanish economy plunged into recession; currently it is reviving with the pace of growth twice as fast as the Euro zone average. One of the 20 biggest stock exchanges in the world. |
| SWITZERLAND | One of the most developed countries in the world, with the highest nominal wealth per adult. Based on the Global Competitiveness Report, world's most competitive economy and innovative country. Long tradition of financial services. |

Table 4: *The price of quality - Developed countries*

The table below reports the results from the annual Fama MacBeth for the developed country sample. The dependent variable is the log of each companies' market-to-book ratio for June of each year, the independent variables are the quality score for each company in June of each year in the first panel. The explanatory variables in the second panel are the Profitability, Growth and Safety scores for each company in June of each year. All values displayed are averaged values from the cross-sectional regressions. The respective t-statistics are displayed in brackets, the values that are significant at a 5% level are displayed in bold. The residuals are corrected for heteroscedasticity and autocorrelation of up to 12 lags (Newey and West, 1987). The consideration of country and industry fixed effects is indicated.

| | (1) | (2) | (3) | (4) |
|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Quality | 0.20 (5.57) | 0.20 (5.44) | 0.19 (5.51) | 0.21 (5.90) |
| Adjusted R2 | 0.93% | 6.26% | 7.34% | 11.77% |
| Country FE | | X | | X |
| Industry FE | | | X | X |
| | (1) | (2) | (3) | (4) |
| Profitability | 0.06 (2.70) | 0.06 (2.93) | 0.06 (3.03) | 0.07 (3.62) |
| Growth | 0.09 (4.43) | 0.08 (4.14) | 0.09 (4.31) | 0.08 (4.32) |
| Safety | 0.06 (2.28) | 0.05 (2.02) | 0.05 (2.03) | 0.06 (2.11) |
| Adjusted R2 | 1.30% | 6.43% | 7.55% | 12.10% |
| Country FE | | X | | X |
| Industry FE | | | X | X |

Table 5: *The price of quality - Developing countries*

The table below reports the results from the annual Fama-MacBeth for the developed country sample. The measures of Profitability and Growth has been kept as one score, since both variables have showed signs of near multicollinearity in the developing country sample. For further information for this table see Table 4 above.

| | (1) | (2) | (3) | (4) |
|-----------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Quality | 0.27 (8.08) | 0.24 (7.32) | 0.26 (7.87) | 0.23 (7.12) |
| Adjusted R2 | 2.73% | 12.90% | 26.42% | 16.31% |
| Country FE | | X | | X |
| Industry FE | | | X | X |
| | (1) | (2) | (3) | (4) |
| Profitability & Growth | 0.30 (11.24) | 0.29 (11.19) | 0.26 (10.24) | 0.25 (10.22) |
| Safety | -0.11 (-4.10) | -0.11 (-4.28) | -0.09 (-3.79) | -0.10 (-4.17) |
| Adjusted R2 | 6.11% | 9.90% | 15.27% | 18.72% |
| Country FE | | X | | X |
| Industry FE | | | X | X |

Table 6: *Quality minus Junk portfolio performance by country - equal weighting 10% long/short*

The table below reports the QMJ portfolio alphas, factor loadings and Sharpe Ratios. The portfolios below are equally weighted and go long in the top 10% and short in the bottom 10% of the stocks according to their quality score. The portfolios are rebalanced monthly to preserve the value weights. The alpha is calculated as the constant of a time-series regression of the portfolio excess returns (over the U.S. Treasury Bill) on the four factors, all alpha values are annualized. MKT are the market excess returns, SMB is the size factor, HML the value factor and UMD is the momentum factor. The Sharpe Ratio is calculated as the expected portfolio return of the portfolio standard deviation (not considering the risk-free due to the zero-cost nature of long-short portfolios). The last column reports the p-values of each Sharpe Ratios. Values significant on a 5% level are marked in bold. The sample period is from 1999 – 2017.

| COUNTRY | CAPM ALPHA | P-VALUE | 4-FACTOR ALPHA | P-VALUE | FACTOR LOADINGS | | | | SR | P-VALUE |
|--------------|-------------|------------|----------------|------------|-----------------|--------------|--------------|-------------|-------------|------------|
| | | | | | MKT | SMB | HML | UMD | | |
| Argentina | 0.31 | 0.00 | 0.29 | 0.00 | -0.53 | 0.12 | 0.34 | 0.19 | 0.82 | 0.00 |
| Brazil | 0.18 | 0.06 | 0.19 | 0.07 | -0.62 | -1.62 | 0.31 | 0.27 | 0.31 | 0.22 |
| Chile | 0.25 | 0.00 | 0.25 | 0.00 | -0.36 | -0.23 | 0.33 | 0.06 | 1.50 | 0.00 |
| Egypt | 0.21 | 0.01 | 0.25 | 0.01 | -0.75 | 0.27 | -1.28 | 0.07 | 0.43 | 0.09 |
| Indonesia | 0.43 | 0.00 | 0.42 | 0.00 | -0.36 | -0.74 | 0.06 | 0.36 | 2.50 | 0.00 |
| Malaysia | 0.40 | 0.00 | 0.38 | 0.00 | -0.18 | -0.25 | -0.22 | 0.41 | 2.48 | 0.00 |
| Mexico | 0.25 | 0.00 | 0.27 | 0.00 | -0.59 | -0.39 | -0.30 | -0.08 | 1.06 | 0.00 |
| Pakistan | 0.33 | 0.00 | 0.37 | 0.00 | 0.35 | -0.58 | 0.133 | -0.45 | 0.86 | 0.00 |
| Philippines | 0.23 | 0.00 | 0.25 | 0.00 | -0.29 | -1.09 | -0.28 | 0.46 | 0.78 | 0.00 |
| Poland | 0.60 | 0.00 | 0.59 | 0.00 | -0.35 | 0.32 | 0.08 | -0.02 | 2.76 | 0.00 |
| South Africa | 0.50 | 0.00 | 0.49 | 0.00 | -0.15 | 0.45 | -0.53 | 0.27 | 2.30 | 0.00 |
| Thailand | 0.45 | 0.00 | 0.45 | 0.00 | -0.58 | -0.95 | -0.21 | 0.29 | 0.41 | 0.00 |
| Average | 0.35 | N/A | 0.35 | N/A | -0.37 | -0.39 | -0.13 | 0.15 | 1.35 | N/A |
| Australia | 0.47 | 0.00 | 0.49 | 0.00 | -1.67 | -0.28 | -0.04 | -0.07 | 1.14 | 0.00 |
| Austria | 0.37 | 0.00 | 0.34 | 0.00 | -0.59 | -1.35 | -0.55 | 1.01 | 1.07 | 0.00 |
| Denmark | 0.43 | 0.00 | 0.43 | 0.00 | -0.32 | -0.39 | -0.42 | 0.31 | 2.24 | 0.00 |
| Finland | 0.38 | 0.00 | 0.32 | 0.00 | -0.07 | 0.32 | 0.00 | 0.56 | 2.00 | 0.00 |
| Germany | 0.42 | 0.00 | 0.34 | 0.00 | 0.00 | 0.52 | 0.15 | 0.13 | 1.47 | 0.00 |
| Israel | 0.44 | 0.00 | 0.40 | 0.00 | -0.70 | -0.31 | 0.87 | 0.24 | 1.55 | 0.00 |
| Italy | 0.31 | 0.00 | 0.31 | 0.00 | -0.55 | -0.05 | -0.72 | 0.33 | 1.40 | 0.00 |
| Norway | 0.39 | 0.00 | 0.39 | 0.00 | -0.53 | -0.71 | -0.25 | 0.33 | 1.47 | 0.00 |
| New Zealand | 0.42 | 0.00 | 0.43 | 0.00 | -0.24 | -0.30 | -0.47 | 0.07 | 1.46 | 0.00 |
| Singapore | 0.43 | 0.00 | 0.41 | 0.00 | -0.37 | -0.66 | 0.34 | 0.27 | 2.41 | 0.00 |
| Spain | 0.35 | 0.00 | 0.32 | 0.00 | -0.52 | -0.22 | -0.60 | 0.67 | 1.26 | 0.00 |
| Switzerland | 0.32 | 0.00 | 0.27 | 0.00 | -0.49 | -0.25 | 0.19 | 0.55 | 1.61 | 0.00 |
| Average | 0.39 | N/A | 0.37 | N/A | -0.50 | -0.31 | -0.13 | 0.37 | 1.59 | N/A |

Table 7: *Quality minus Junk summary statistics by country - equal weighting 10 long/short*

The table below shows the respective summary statistics for the portfolios from the table above. Kurtosis is excess kurtosis.

| COUNTRY | EXCESS RETURN | T- STATISTIC | STD.DEV | MIN | SKEWNESS | KURTOSIS |
|---------------------|---------------|--------------|---------|--------|----------|----------|
| Argentina | 0.29 | 3.26 | 0.35 | -3.27 | 0.71 | 3.35 |
| Brazil | 0.15 | 1.23 | 0.49 | -11.12 | -2.06 | 13.94 |
| Chile | 0.24 | 6.00 | 0.16 | -2.11 | -0.49 | 2.39 |
| Egypt | 0.17 | 1.72 | 0.41 | -4.13 | 0.19 | 1.53 |
| Indonesia | 0.41 | 9.99 | 0.17 | -1.29 | -0.05 | 0.48 |
| Malaysia | 0.39 | 9.92 | 0.16 | -2.24 | -0.56 | 3.68 |
| Mexico | 0.22 | 4.25 | 0.21 | -2.44 | 0.62 | 7.29 |
| Pakistan | 0.36 | 3.43 | 0.42 | -8.03 | -1.00 | 8.20 |
| Philippines | 0.21 | 3.12 | 0.27 | -2.84 | -0.50 | 0.86 |
| Poland | 0.58 | 11.05 | 0.21 | -1.50 | 1.17 | 8.81 |
| South Africa | 0.49 | 9.19 | 0.21 | -2.87 | -0.38 | 1.71 |
| Thailand | 0.41 | 9.17 | 0.18 | -0.97 | 1.10 | 4.31 |
| Australia | 0.38 | 4.54 | 0.34 | -2.76 | 0.29 | 0.91 |
| Austria | 0.32 | 4.29 | 0.30 | -3.33 | 1.35 | 8.46 |
| Denmark | 0.41 | 8.14 | 0.18 | -1.91 | 0.65 | 3.16 |
| Finland | 0.36 | 7.99 | 0.18 | -1.42 | 0.36 | 1.23 |
| Germany | 0.42 | 5.87 | 0.28 | -2.04 | 1.40 | 5.31 |
| Israel | 0.41 | 6.21 | 0.26 | -2.61 | 0.53 | 2.12 |
| Italy | 0.27 | 5.60 | 0.20 | -1.91 | 0.36 | 2.21 |
| Norway | 0.36 | 5.87 | 0.25 | -3.79 | 0.21 | 4.92 |
| New Zealand | 0.40 | 5.82 | 0.28 | -2.20 | 0.67 | 3.11 |
| Singapore | 0.41 | 9.63 | 0.17 | -1.92 | 0.20 | 4.45 |
| Spain | 0.31 | 5.02 | 0.24 | -2.53 | -0.17 | 0.48 |
| Switzerland | 0.29 | 6.44 | 0.18 | -1.64 | 0.00 | 1.50 |

Table 8: *Quality minus Junk portfolio performance per country - equal weighting 30% long/short*

The table below reports the portfolio performance for equally weighted portfolios, going long in the top 30% of stocks according to their quality score and short in the bottom 30%. Further explanations are equal to Table 6.

| COUNTRY | CAPM ALPHA | P-VALUE | 4-FACTOR ALPHA | P-VALUE | FACTOR LOADINGS | | | | SR | P-VALUE |
|--------------|-------------|---------|----------------|---------|-----------------|--------------|--------------|-------------|-------------|---------|
| | | | | | MKT | SMB | HML | UMD | | |
| Argentina | 0.58 | 0.00 | 0.54 | 0.00 | -0.74 | -0.61 | 0.34 | 0.16 | 0.87 | 0.00 |
| Brazil | 0.51 | 0.00 | 0.59 | 0.00 | -1.58 | -3.65 | 0.00 | 0.33 | 0.51 | 0.04 |
| Chile | 0.49 | 0.00 | 0.44 | 0.00 | -0.54 | -0.45 | 0.19 | 0.57 | 1.62 | 0.00 |
| Egypt | 0.48 | 0.01 | 0.49 | 0.00 | -1.62 | -1.09 | -2.72 | 1.27 | 0.45 | 0.07 |
| Indonesia | 0.81 | 0.00 | 0.79 | 0.00 | -0.32 | -0.98 | -0.29 | 0.75 | 2.56 | 0.00 |
| Malaysia | 0.83 | 0.00 | 0.81 | 0.00 | -0.35 | -0.71 | -0.56 | 0.73 | 2.22 | 0.00 |
| Mexico | 0.61 | 0.00 | 0.63 | 0.00 | -1.03 | -0.80 | -0.57 | 0.22 | 1.44 | 0.00 |
| Pakistan | 0.71 | 0.00 | 0.80 | 0.00 | 0.43 | -0.45 | -0.20 | -0.86 | 1.13 | 0.00 |
| Philippines | 0.50 | 0.00 | 0.48 | 0.00 | -0.50 | -2.26 | -0.11 | 0.96 | 0.97 | 0.00 |
| Poland | 1.23 | 0.00 | 1.18 | 0.00 | -0.67 | 0.03 | -0.22 | 0.75 | 3.10 | 0.00 |
| South Africa | 0.97 | 0.00 | 0.95 | 0.00 | -0.18 | 0.97 | -0.65 | 0.20 | 2.81 | 0.00 |
| Thailand | 0.85 | 0.00 | 0.85 | 0.00 | -0.98 | -1.38 | -0.58 | 0.70 | 2.12 | 0.00 |
| Average | 0.71 | N/A | 0.71 | N/A | -0.67 | -0.95 | -0.45 | 0.48 | 1.65 | N/A |
| Australia | 0.85 | 0.00 | 0.89 | 0.00 | -3.85 | -1.23 | -0.38 | -0.03 | 0.83 | 0.00 |
| Austria | 0.73 | 0.00 | 0.61 | 0.00 | -0.70 | -2.49 | 0.18 | 2.11 | 1.14 | 0.00 |
| Denmark | 0.91 | 0.00 | 0.90 | 0.00 | -0.37 | -0.74 | -1.17 | 0.78 | 2.83 | 0.00 |
| Finland | 0.78 | 0.00 | 0.70 | 0.00 | -0.13 | 0.37 | -0.13 | 0.87 | 2.32 | 0.00 |
| Germany | 0.80 | 0.00 | 0.78 | 0.00 | -0.20 | 0.72 | 0.75 | -0.40 | 1.67 | 0.00 |
| Israel | 0.89 | 0.00 | 0.78 | 0.00 | -1.64 | -0.59 | 2.01 | 0.64 | 1.53 | 0.00 |
| Italy | 0.67 | 0.00 | 0.64 | 0.00 | -0.84 | -0.19 | -1.55 | 1.16 | 1.45 | 0.00 |
| Norway | 0.87 | 0.00 | 0.86 | 0.00 | -1.03 | -1.51 | -0.08 | 0.56 | 1.97 | 0.00 |
| New Zealand | 0.80 | 0.00 | 0.85 | 0.00 | -0.70 | -0.78 | -0.65 | -0.10 | 1.82 | 0.00 |
| Singapore | 0.94 | 0.00 | 0.93 | 0.00 | -0.82 | -1.91 | 0.53 | 0.49 | 2.65 | 0.00 |
| Spain | 0.75 | 0.00 | 0.69 | 0.00 | -1.04 | -0.48 | -2.49 | 1.81 | 1.39 | 0.00 |
| Switzerland | 0.64 | 0.00 | 0.58 | 0.00 | -0.94 | -0.86 | -0.22 | 1.17 | 1.74 | 0.00 |
| Average | 0.80 | N/A | 0.77 | N/A | -1.02 | -0.81 | -0.27 | 0.76 | 1.78 | N/A |

Table 9: *Quality minus Junk summary statistics by country – equal weighting 30% long/short*

The table below shows the respective summary statistics for the portfolios from the table above. Kurtosis is excess kurtosis.

| COUNTRY | EXCESS RETURN | T- STATISTIC | STD.DEV | MIN | SKEWNESS | KURTOSIS |
|--------------|---------------|--------------|---------|--------|----------|----------|
| Argentina | 0.54 | 3.48 | 0.62 | -7.10 | 0.14 | 1.50 |
| Brazil | 0.45 | 2.05 | 0.87 | -14.76 | -0.33 | 9.56 |
| Chile | 0.45 | 6.49 | 0.28 | -2.85 | -0.08 | 1.23 |
| Egypt | 0.37 | 1.81 | 0.82 | -11.32 | -0.62 | 2.80 |
| Indonesia | 0.79 | 10.26 | 0.31 | -3.25 | -0.48 | 0.96 |
| Malaysia | 0.80 | 8.89 | 0.36 | -4.19 | 0.04 | 5.76 |
| Mexico | 0.55 | 5.76 | 0.38 | -3.29 | 0.72 | 4.09 |
| Pakistan | 0.75 | 4.52 | 0.66 | -9.77 | -0.35 | 5.54 |
| Philippines | 0.46 | 3.89 | 0.48 | -5.13 | -0.59 | 1.72 |
| Poland | 1.18 | 12.41 | 0.38 | -3.02 | 0.22 | 1.18 |
| South Africa | 0.96 | 11.23 | 0.34 | -2.80 | 0.00 | 0.08 |
| Thailand | 0.79 | 0.00 | 0.37 | -2.33 | 0.57 | 1.31 |
| Australia | 0.64 | 3.32 | 0.77 | -7.14 | 0.15 | 0.85 |
| Austria | 0.66 | 4.54 | 0.59 | -6.25 | 0.52 | 4.13 |
| Denmark | 0.88 | 11.32 | 0.31 | -2.52 | 0.48 | 1.39 |
| Finland | 0.76 | 9.28 | 0.33 | -3.12 | -0.04 | 1.03 |
| Germany | 0.79 | 6.69 | 0.47 | -4.24 | 0.44 | 3.15 |
| Israel | 0.80 | 6.14 | 0.52 | -4.76 | 0.97 | 5.75 |
| Italy | 0.61 | 5.78 | 0.42 | -6.50 | -0.01 | 4.37 |
| Norway | 0.81 | 7.89 | 0.41 | -4.06 | 0.19 | 0.99 |
| New Zealand | 0.76 | 7.26 | 0.42 | -4.74 | 0.14 | 2.14 |
| Singapore | 0.90 | 10.60 | 0.34 | -4.32 | -0.53 | 3.42 |
| Spain | 0.66 | 5.56 | 0.47 | -3.90 | 0.46 | 2.07 |
| Switzerland | 0.58 | 6.97 | 0.33 | -3.72 | 0.36 | 3.37 |

Table 10: *Quality minus Junk portfolio performance by country - value weighting 10% long/short*

The table below reports the portfolio performance for value-weighted portfolios, going long in the top 10% of stocks according to their quality score and short in the bottom 10%. Further explanations are equal to Table 6.

| COUNTRY | CAPM ALPHA | P-VALUE | 4-FACTOR ALPHA | P-VALUE | FACTOR LOADINGS | | | | SR | P-VALUE |
|--------------|-------------|---------|----------------|---------|-----------------|--------------|--------------|-------------|-------------|---------|
| | | | | | MKT | SMB | HML | UMD | | |
| Argentina | 0.19 | 0.09 | 0.11 | 0.24 | -0.40 | 0.22 | 0.33 | 0.80 | 0.27 | 0.27 |
| Brazil | 0.20 | 0.04 | 0.17 | 0.07 | -0.71 | 0.01 | 0.29 | 0.22 | 0.33 | 0.18 |
| Chile | 0.23 | 0.00 | 0.23 | 0.00 | -0.26 | -0.17 | 0.08 | 0.01 | 1.00 | 0.00 |
| Egypt | 0.16 | 0.16 | 0.24 | 0.07 | -1.00 | 0.77 | -1.85 | -0.51 | 0.17 | 0.50 |
| Indonesia | 0.48 | 0.00 | 0.47 | 0.00 | -0.64 | -0.84 | -0.16 | 0.50 | 1.52 | 0.00 |
| Malaysia | 0.33 | 0.00 | 0.30 | 0.00 | -0.21 | -0.53 | 0.06 | 0.55 | 1.23 | 0.00 |
| Mexico | 0.14 | 0.06 | 0.14 | 0.06 | -0.60 | 1.02 | 0.65 | -0.65 | 0.32 | 0.20 |
| Pakistan | 0.23 | 0.02 | 0.28 | 0.01 | 0.30 | -1.54 | 0.06 | -0.19 | 0.57 | 0.02 |
| Philippines | 0.16 | 0.06 | 0.19 | 0.03 | -0.48 | -1.27 | -0.74 | 0.29 | 0.33 | 0.19 |
| Poland | 0.37 | 0.00 | 0.34 | 0.00 | 0.25 | -0.23 | 0.16 | 0.34 | 1.14 | 0.00 |
| South Africa | 0.24 | 0.00 | 0.23 | 0.00 | 0.42 | -0.60 | -1.00 | 0.70 | 0.80 | 0.00 |
| Thailand | 0.31 | 0.00 | 0.30 | 0.00 | -0.38 | -1.12 | -0.38 | 0.63 | 1.00 | 0.00 |
| Average | 0.25 | N/A | 0.25 | N/A | -0.31 | -0.36 | -0.21 | 0.22 | 0.72 | N/A |
| Australia | 0.28 | 0.00 | 0.27 | 0.00 | -0.86 | -0.83 | -0.25 | 0.40 | 0.65 | 0.01 |
| Austria | 0.35 | 0.00 | 0.33 | 0.00 | -1.14 | -1.98 | -0.84 | 1.16 | 0.70 | 0.01 |
| Denmark | 0.37 | 0.00 | 0.36 | 0.00 | -0.55 | -1.03 | -1.20 | 0.96 | 1.08 | 0.00 |
| Finland | 0.37 | 0.00 | 0.29 | 0.00 | -0.18 | 0.59 | 0.10 | 0.73 | 1.19 | 0.00 |
| Germany | 0.37 | 0.00 | 0.33 | 0.00 | 0.00 | 0.84 | 0.82 | -0.06 | 1.27 | 0.00 |
| Israel | 0.29 | 0.00 | 0.23 | 0.00 | -0.62 | -0.52 | 1.08 | 0.55 | 0.71 | 0.00 |
| Italy | 0.13 | 0.02 | 0.93 | 0.07 | -0.33 | 0.18 | -1.06 | 0.83 | 0.36 | 0.15 |
| Norway | 0.36 | 0.00 | 0.38 | 0.00 | -0.81 | -0.62 | -0.27 | 0.04 | 1.02 | 0.00 |
| New Zealand | 0.20 | 0.01 | 0.25 | 0.00 | -0.21 | -0.82 | -0.88 | 0.01 | 0.57 | 0.02 |
| Singapore | 0.32 | 0.00 | 0.28 | 0.00 | -0.79 | -0.91 | 0.69 | 0.51 | 1.07 | 0.00 |
| Spain | 0.33 | 0.00 | 0.32 | 0.00 | -0.39 | 0.07 | -1.29 | 0.62 | 0.79 | 0.00 |
| Switzerland | 0.30 | 0.00 | 0.23 | 0.00 | -0.53 | 0.26 | -0.31 | 0.89 | 1.01 | 0.00 |
| Average | 0.31 | N/A | 0.35 | N/A | -0.53 | -0.40 | -0.28 | 0.55 | 0.87 | N/A |

Table 11: *Quality minus Junk summary statistics by country - value weighting 10% long/short*

The table below shows the respective summary statistics for the portfolios from the table above. Kurtosis is excess kurtosis.

| COUNTRY | EXCESS RETURN | T- STATISTIC | STD.DEV | MIN | SKEWNESS | KURTOSIS |
|--------------|---------------|--------------|---------|--------|----------|----------|
| Argentina | 0.15 | 1.09 | 0.56 | -10.25 | -0.86 | 8.33 |
| Brazil | 0.16 | 1.34 | 0.47 | -12.81 | -3.34 | 23.48 |
| Chile | 0.22 | 4.00 | 0.22 | -2.05 | 0.33 | 2.54 |
| Egypt | 0.11 | 0.67 | 0.65 | -6.36 | 2.42 | 18.84 |
| Indonesia | 0.44 | 6.09 | 0.29 | -2.92 | -0.10 | 1.34 |
| Malaysia | 0.31 | 4.91 | 0.26 | -3.12 | 1.56 | 10.73 |
| Mexico | 0.11 | 1.29 | 0.35 | -5.02 | -0.02 | 2.80 |
| Pakistan | 0.25 | 2.28 | 0.44 | -7.56 | -1.01 | 6.51 |
| Philippines | 0.13 | 1.32 | 0.40 | -5.14 | -0.33 | 1.94 |
| Poland | 0.38 | 4.57 | 0.33 | -3.96 | 1.05 | 11.46 |
| South Africa | 0.25 | 3.21 | 0.32 | -4.77 | -0.81 | 2.53 |
| Thailand | 0.29 | 4.01 | 0.29 | -4.41 | -0.64 | 4.44 |
| Australia | 0.23 | 2.59 | 0.35 | -3.48 | 1.00 | 4.51 |
| Austria | 0.27 | 2.79 | 0.39 | -4.62 | 1.38 | 8.18 |
| Denmark | 0.33 | 4.33 | 0.31 | -3.22 | 0.81 | 4.84 |
| Finland | 0.35 | 4.75 | 0.29 | -2.34 | 0.62 | 2.77 |
| Germany | 0.37 | 5.09 | 0.29 | -2.76 | 0.91 | 2.86 |
| Israel | 0.25 | 2.86 | 0.35 | -3.43 | 1.44 | 9.29 |
| Italy | 0.10 | 1.46 | 0.27 | -4.05 | -0.29 | 2.69 |
| Norway | 0.32 | 4.09 | 0.31 | -2.58 | 0.48 | 0.93 |
| New Zealand | 0.19 | 2.30 | 0.33 | -6.74 | -0.50 | 8.68 |
| Singapore | 0.28 | 4.28 | 0.26 | -3.49 | -0.38 | 2.18 |
| Spain | 0.30 | 3.15 | 0.38 | -3.18 | 1.35 | 6.72 |
| Switzerland | 0.25 | 4.05 | 0.25 | -3.03 | -0.28 | 2.38 |

Table 12: *Quality minus Junk portfolio performance by country - value weighting 30% long/short*

The table below reports the portfolio performance for value-weighted portfolios, going long in the top 30% of stocks according to their quality score and short in the bottom 30%. Further explanations are equal to Table 6.

| COUNTRY | CAPM ALPHA | P-VALUE | 4-FACTOR ALPHA | P-VALUE | FACTOR LOADINGS | | | | SR | P-VALUE |
|--------------|-------------|---------|----------------|---------|-----------------|--------------|--------------|-------------|-------------|---------|
| | | | | | MKT | SMB | HML | UMD | | |
| Argentina | 0.48 | 0.01 | 0.42 | 0.03 | -0.82 | -0.28 | -0.05 | 0.85 | 0.48 | 0.06 |
| Brazil | 0.32 | 0.03 | 0.25 | 0.07 | -0.98 | 0.43 | -0.23 | 0.87 | 0.35 | 0.16 |
| Chile | 0.37 | 0.00 | 0.40 | 0.00 | -0.82 | 0.36 | -1.36 | 0.11 | 0.61 | 0.01 |
| Egypt | 0.45 | 0.03 | 0.53 | 0.01 | -2.07 | -1.16 | -3.56 | 0.72 | 0.31 | 0.21 |
| Indonesia | 0.51 | 0.00 | 0.49 | 0.00 | -0.58 | -0.28 | -1.47 | 0.87 | 0.88 | 0.00 |
| Malaysia | 0.99 | 0.00 | 0.98 | 0.00 | -0.42 | 0.14 | -1.54 | 0.85 | 0.35 | 0.00 |
| Mexico | 0.54 | 0.00 | 0.56 | 0.00 | -0.77 | -0.21 | 0.06 | -0.17 | 0.84 | 0.00 |
| Pakistan | 0.51 | 0.00 | 0.64 | 0.00 | 0.29 | -2.32 | -0.07 | -0.83 | 0.72 | 0.00 |
| Philippines | 0.37 | 0.01 | 0.39 | 0.01 | -1.03 | -3.04 | -0.58 | 0.86 | 0.49 | 0.05 |
| Poland | 0.86 | 0.00 | 0.88 | 0.00 | -0.37 | -0.04 | -1.63 | 0.49 | 1.67 | 0.00 |
| South Africa | 0.49 | 0.00 | 0.45 | 0.00 | 0.75 | -0.07 | -1.26 | 0.98 | 1.06 | 0.00 |
| Thailand | 0.57 | 0.00 | 0.48 | 0.00 | -0.83 | -1.43 | -0.47 | 1.82 | 1.00 | 0.00 |
| Average | 0.54 | N/A | 0.54 | N/A | -0.64 | -0.66 | -1.01 | 0.62 | 0.73 | N/A |
| Australia | 0.46 | 0.00 | 0.48 | 0.00 | -1.82 | -2.29 | -0.39 | 0.68 | 0.57 | 0.02 |
| Austria | 0.61 | 0.00 | 0.48 | 0.00 | -1.44 | -2.95 | -0.89 | 2.90 | 0.76 | 0.00 |
| Denmark | 0.64 | 0.00 | 0.60 | 0.00 | -0.36 | -2.19 | -2.45 | 2.16 | 1.09 | 0.00 |
| Finland | 0.55 | 0.00 | 0.51 | 0.00 | -0.26 | 0.23 | -1.20 | 0.93 | 1.13 | 0.00 |
| Germany | 0.65 | 0.00 | 0.65 | 0.00 | 0.31 | 1.03 | 0.62 | -0.52 | 1.34 | 0.00 |
| Israel | 0.59 | 0.00 | 0.52 | 0.00 | -1.46 | -1.32 | 1.05 | 0.86 | 0.25 | 0.00 |
| Italy | 0.50 | 0.00 | 0.41 | 0.00 | -0.65 | 0.99 | -3.58 | 2.22 | 0.76 | 0.00 |
| Norway | 0.82 | 0.00 | 0.82 | 0.00 | -1.18 | -1.68 | -0.33 | 0.75 | 1.51 | 0.02 |
| New Zealand | 0.17 | 0.07 | 0.25 | 0.02 | -0.40 | -1.12 | -1.31 | -0.17 | 0.34 | 0.17 |
| Singapore | 0.61 | 0.00 | 0.59 | 0.00 | -1.37 | -2.31 | 0.34 | 0.82 | 1.28 | 0.00 |
| Spain | 0.56 | 0.00 | 0.50 | 0.00 | -0.67 | 1.18 | -3.46 | 1.68 | 0.76 | 0.00 |
| Switzerland | 0.53 | 0.00 | 0.42 | 0.00 | -1.11 | -0.21 | -1.47 | 1.95 | 0.99 | 0.00 |
| Average | 0.56 | N/A | 0.52 | N/A | -0.87 | -0.89 | -1.09 | 1.19 | 0.90 | N/A |

Table 13: *Quality minus Junk summary statistics by country - value weighting 30% long/short*

The table below shows the respective summary statistics for the portfolios from the table above. Kurtosis is excess kurtosis.

| COUNTRY | EXCESS RETURN | T- STATISTIC | STD.DEV | MIN | SKEWNESS | KURTOSIS |
|--------------|---------------|--------------|---------|--------|----------|----------|
| Argentina | 0.43 | 1.91 | 0.89 | -9.16 | 0.59 | 4.28 |
| Brazil | 0.24 | 1.42 | 0.70 | -16.42 | -2.15 | 11.88 |
| Chile | 0.32 | 2.45 | 0.53 | -17.65 | -4.65 | 48.14 |
| Egypt | 0.32 | 1.27 | 1.00 | -13.18 | 0.20 | 3.41 |
| Indonesia | 0.46 | 3.52 | 0.53 | -5.55 | -0.42 | 0.60 |
| Malaysia | 0.96 | 4.83 | 0.79 | -22.91 | -2.80 | 30.39 |
| Mexico | 0.50 | 3.37 | 0.60 | -4.66 | 0.01 | 0.78 |
| Pakistan | 0.55 | 2.87 | 0.77 | -10.64 | -0.56 | 2.72 |
| Philippines | 0.31 | 1.98 | 0.62 | -8.49 | -0.95 | 2.46 |
| Poland | 0.83 | 6.31 | 0.50 | -3.67 | 0.76 | 2.62 |
| South Africa | 0.51 | 4.25 | 0.48 | 5.87 | -0.57 | 2.15 |
| Thailand | 0.50 | 3.00 | 0.51 | -5.76 | 0.01 | 0.84 |
| Australia | 0.36 | 2.29 | 0.63 | -4.28 | 1.69 | 6.35 |
| Austria | 0.49 | 3.05 | 0.65 | -11.19 | -0.23 | 6.18 |
| Denmark | 0.59 | 4.35 | 0.54 | -5.28 | 0.44 | 2.65 |
| Finland | 0.52 | 4.51 | 0.46 | -4.80 | 0.01 | 1.28 |
| Germany | 0.68 | 5.35 | 0.51 | -4.84 | 0.66 | 2.31 |
| Israel | 0.51 | 3.86 | 0.53 | -5.73 | 0.25 | 2.76 |
| Italy | 0.42 | 3.02 | 0.55 | -5.45 | 0.17 | 1.06 |
| Norway | 0.76 | 5.77 | 0.50 | -5.47 | -0.25 | 0.58 |
| New Zealand | 0.15 | 1.36 | 0.45 | -7.00 | -0.74 | 3.31 |
| Singapore | 0.54 | 5.11 | 0.42 | -5.22 | -0.17 | 1.92 |
| Spain | 0.48 | 3.05 | 0.63 | -7.50 | 0.32 | 2.57 |
| Switzerland | 0.43 | 3.95 | 0.44 | -6.80 | -0.78 | 2.68 |

Table 14: Momentum portfolio results

For the construction of the momentum portfolio, the QMJ portfolios from the value-weighted 30/30 construction were used as initial database. The t-2 to t-12 returns for each month and country were then summed, leaving out the most recent past month (t-1) to avoid microstructural distortions arising from short-term mean reversion. In the next step, the momentum threshold was calculated, and all returns larger than the 70th percentile make up the winner stocks, all stocks lower or equal to the 30st percentile are the loser stocks and stocks larger than the 30st, but lower or equal to the 70th percentile are neutral stocks. The first row in the table below contains the findings for a long only momentum portfolio, only investing in the winner stocks, the second row displays the common long/short momentum and the last row is a portfolio going long in the whole universe of stocks. The portfolios are rebalanced monthly and equally weighted. The alpha is calculated as the constant of a time-series regression of the portfolio excess returns (over the U.S. Treasury Bill) on the three factors, all alpha values are annualized. MKT are the market excess returns, SMB is the size factor, HML the value factor. The Sharpe Ratio is calculated as the expected portfolio return of the portfolio standard deviation (not considering the risk-free for the second portfolio due to the zero-cost nature of long-short portfolio and an assumed average of 2% for the other portfolios). The last column reports the p-values of each Sharpe Ratios. Values significant on a 5% level are marked in bold. The sample period is from 2003 – 2017.

| PORTFOLIO | 3-FACTOR ALPHA | P-VALUE | FACTOR LOADINGS | | | SR | KURT | SKEW | MIN | ADJ R2 |
|--------------------|----------------|---------|-----------------|-------|-------|------|------|-------|-------|--------|
| | | | MKT | SMB | HML | | | | | |
| Long only | 0.71 | 0.00 | -1.26 | -1.26 | -1.39 | 1.42 | 1.52 | -0.15 | -3.78 | 26.77% |
| Long /short | 0.33 | 0.00 | -0.60 | -0.95 | -0.68 | 0.68 | 0.81 | -0.11 | -3.98 | 5.93% |
| All | 1.53 | 0.00 | -2.75 | -2.35 | -3.28 | 1.73 | 3.13 | -0.12 | -9.16 | 48.84% |

Table 15: Equally weighted QMJ/Mkt-rf combo portfolio

The table below reports the summary statistics for equally weighted (39%) QMJ and Mkt-rf portfolios. The weight towards QMJ and Mkt is 50% respectively. The portfolios are rebalanced monthly and equally weighted. The alpha is calculated as the constant of a time-series regression of the portfolio excess returns (over the U.S. Treasury Bill) on the four factors, all alpha values are annualized. MKT are the market excess returns, SMB is the size factor, HML the value factor and UMD is the momentum factor. The Sharpe Ratio is calculated as the expected portfolio return of the portfolio standard deviation (not considering the risk-free due to the zero-cost nature of long-short portfolios). The second column reports the p-values of each Sharpe Ratios. Values significant on a 5% level are marked in bold. The sample period is from 1999 – 2017. Kurtosis is excess kurtosis.

| COUNTRY | SR | T-STATISTIC | MIN | SKEWNESS | KURTOSIS |
|--------------|-------------|-------------|--------------|-------------|-------------|
| Argentina | 0.97 | 3.82 | -3.31 | 0.08 | 1.77 |
| Brazil | 0.59 | 2.34 | -7.37 | -0.33 | 10.14 |
| Chile | 1.90 | 7.07 | -1.00 | 0.32 | 0.81 |
| Egypt | 0.54 | 2.15 | -5.39 | -0.57 | 2.65 |
| Indonesia | 2.73 | 9.54 | -1.28 | -0.11 | 0.46 |
| Malaysia | 2.39 | 8.58 | -1.99 | 0.27 | 4.92 |
| Mexico | 1.70 | 6.41 | -1.49 | 0.40 | 1.70 |
| Pakistan | 1.16 | 4.50 | -5.03 | -0.34 | 5.13 |
| Philippines | 1.10 | 4.28 | -2.90 | -0.64 | 2.00 |
| Poland | 3.42 | 11.21 | -1.85 | 0.05 | 1.13 |
| South Africa | 3.42 | 11.21 | -1.85 | 0.05 | 1.13 |
| Thailand | 2.46 | 8.80 | -1.16 | 0.16 | 0.65 |
| Australia | 1.00 | 3.92 | -3.04 | 0.04 | 0.55 |
| Austria | 1.27 | 4.92 | -2.73 | 0.59 | 3.84 |
| Denmark | 3.06 | 10.37 | -1.15 | 0.48 | 1.44 |
| Finland | 2.46 | 8.78 | -1.13 | -0.22 | 0.21 |
| Germany | 1.73 | 6.54 | -2.04 | 0.43 | 2.18 |
| Israel | 1.79 | 6.72 | -2.68 | 1.20 | 9.38 |
| Italy | 1.70 | 6.43 | -3.44 | -0.59 | 5.56 |
| Norway | 2.25 | 8.16 | -1.87 | 0.23 | 1.00 |
| New Zealand | 1.97 | 7.31 | -2.99 | -0.26 | 2.82 |
| Singapore | 2.95 | 10.12 | -1.81 | -0.27 | 3.76 |
| Spain | 1.66 | 6.29 | -1.72 | 0.59 | 3.21 |
| Switzerland | 2.18 | 7.97 | -1.71 | -0.19 | 1.35 |
| Average | 1.93 | N/A | -2.54 | 0.06 | 2.82 |

Table 16: Equally weighted QMJ/SMB combo portfolios

The table below reports the summary statistics for equally weighted (39%) QMJ and SMB portfolios. The weight towards QMJ and SMB is 50% respectively. The portfolios are rebalanced monthly and equally weighted. The alpha is calculated as the constant of a time-series regression of the portfolio excess returns (over the U.S. Treasury Bill) on the four factors, all alpha values are annualized. MKT are the market excess returns, SMB is the size factor, HML the value factor and UMD is the momentum factor. The Sharpe Ratio is calculated as the expected portfolio return of the portfolio standard deviation (not considering the risk-free due to the zero-cost nature of long-short portfolios). The second column reports the p-values of each Sharpe Ratios. Values significant on a 5% level are marked in bold. The sample period is from 1999 – 2017. Kurtosis is excess kurtosis.

| COUNTRY | SR | T-STATISTIC | MIN | SKEWNESS | KURTOSIS |
|--------------|-------------|-------------|--------------|-------------|-------------|
| Argentina | 0.90 | 3.55 | -3.69 | 0.15 | 1.58 |
| Brazil | 0.54 | 2.15 | -7.49 | -0.45 | 9.61 |
| Chile | 1.66 | 6.30 | -1.49 | -0.09 | 1.16 |
| Egypt | 0.48 | 1.90 | -5.64 | -0.58 | 2.77 |
| Indonesia | 2.63 | 9.26 | -1.69 | -0.44 | 1.08 |
| Malaysia | 2.27 | 8.23 | -2.05 | 0.02 | 5.36 |
| Mexico | 1.49 | 5.69 | -1.61 | 0.72 | 3.58 |
| Pakistan | 1.17 | 4.54 | -4.71 | -0.34 | 5.15 |
| Philippines | 1.03 | 4.03 | -2.42 | -0.53 | 1.50 |
| Poland | 3.09 | 10.46 | -1.49 | 0.18 | 1.33 |
| South Africa | 3.09 | 10.46 | -1.49 | 0.18 | 1.33 |
| Thailand | 2.18 | 7.97 | -1.33 | 0.52 | 1.29 |
| Australia | 0.85 | 3.37 | -3.63 | 0.13 | 0.79 |
| Austria | 1.18 | 4.58 | -3.05 | 0.50 | 4.28 |
| Denmark | 2.87 | 9.91 | -1.22 | 0.56 | 1.59 |
| Finland | 2.31 | 8.35 | -1.65 | 0.02 | 1.23 |
| Germany | 1.70 | 6.41 | -2.06 | 0.53 | 3.30 |
| Israel | 1.56 | 5.94 | -2.35 | 0.95 | 5.50 |
| Italy | 1.47 | 5.63 | -3.32 | -0.03 | 4.46 |
| Norway | 2.03 | 7.50 | -2.09 | 0.13 | 0.85 |
| New Zealand | 1.87 | 6.97 | -2.43 | 0.06 | 2.06 |
| Singapore | 2.76 | 9.61 | -2.06 | -0.48 | 3.10 |
| Spain | 1.41 | 5.43 | -2.01 | 0.47 | 2.15 |
| Switzerland | 1.78 | 6.68 | -1.84 | 0.38 | 3.15 |
| Average | 1.76 | N/A | -2.62 | 0.11 | 2.84 |

Table 17: Equally weighted QMJ/HML combo portfolio

The table below reports the summary statistics for equally weighted (39%) QMJ and HML portfolios. The weight towards QMJ and HML is 50% respectively. The portfolios are rebalanced monthly and equally weighted. The alpha is calculated as the constant of a time-series regression of the portfolio excess returns (over the U.S. Treasury Bill) on the four factors, all alpha values are annualized. MKT are the market excess returns, SMB is the size factor, HML the value factor and UMD is the momentum factor. The Sharpe Ratio is calculated as the expected portfolio return of the portfolio standard deviation (not considering the risk-free due to the zero-cost nature of long-short portfolios). The second column reports the p-values of each Sharpe Ratios. Values significant on a 5% level are marked in bold. The sample period is from 1999 – 2017. Kurtosis is excess kurtosis.

| COUNTRY | SR | T-STATISTIC | MIN | SKEWNESS | KURTOSIS |
|--------------|-------------|-------------|--------------|-------------|-------------|
| Argentina | 0.92 | 3.63 | -3.54 | 0.15 | 1.43 |
| Brazil | 0.55 | 2.20 | -7.40 | -0.31 | 9.73 |
| Chile | 1.73 | 6.52 | -1.44 | -0.06 | 1.21 |
| Egypt | 0.50 | 1.99 | -5.62 | -0.64 | 2.78 |
| Indonesia | 2.68 | 9.41 | -1.50 | -0.41 | 0.83 |
| Malaysia | 2.33 | 8.43 | -1.95 | 0.18 | 5.64 |
| Mexico | 1.54 | 5.88 | -1.58 | 0.81 | 4.24 |
| Pakistan | 1.18 | 4.59 | -4.75 | -0.37 | 5.19 |
| Philippines | 1.05 | 4.09 | -2.51 | -0.49 | 1.71 |
| Poland | 3.20 | 10.72 | -1.38 | 0.33 | 1.54 |
| South Africa | 3.20 | 10.72 | -1.38 | 0.33 | 1.54 |
| Thailand | 2.23 | 8.13 | -1.04 | 0.54 | 1.42 |
| Australia | 0.88 | 3.46 | -3.45 | 0.16 | 0.73 |
| Austria | 1.20 | 4.65 | -3.07 | 0.52 | 4.09 |
| Denmark | 3.01 | 10.25 | -1.11 | 0.49 | 1.37 |
| Finland | 2.42 | 8.68 | -1.62 | 0.12 | 1.56 |
| Germany | 1.73 | 6.51 | -2.15 | 0.51 | 3.26 |
| Israel | 1.58 | 6.01 | -2.36 | 0.90 | 5.39 |
| Italy | 1.56 | 5.94 | -3.23 | -0.04 | 4.84 |
| Norway | 2.06 | 7.59 | -1.93 | 0.19 | 0.82 |
| New Zealand | 1.91 | 7.11 | -2.27 | 0.19 | 2.03 |
| Singapore | 2.72 | 9.52 | -2.15 | -0.42 | 3.43 |
| Spain | 1.50 | 5.75 | -1.82 | 0.42 | 1.91 |
| Switzerland | 1.86 | 6.95 | -1.70 | 0.53 | 3.55 |
| Average | 1.81 | N/A | -2.54 | 0.15 | 2.93 |

Table 18: Equally weighted rainbow portfolio

The table below reports the summary statistics for a portfolio including equally weighted QMJ, Mkt-rf, HML and SMB. The weights towards each factor have been chosen by maximizing the overall Sharpe ratios, using Excel Solver. The portfolios are rebalanced monthly and equally weighted. The alpha is calculated as the constant of a time-series regression of the portfolio excess returns (over the U.S. Treasury Bill) on the four factors, all alpha values are annualized. MKT are the market excess returns, SMB is the size factor, HML the value factor and UMD is the momentum factor. The Sharpe Ratio is calculated as the expected portfolio return of the portfolio standard deviation (not considering the risk-free due to the zero-cost nature of long-short portfolios). The second column reports the p-values of each Sharpe Ratios. Values significant on a 5% level are marked in bold. The sample period is from 1999 – 2017. Kurtosis is excess kurtosis.

| COUNTRY | SR | T-STATISTIC | MIN | SKEWNESS | KURTOSIS |
|----------------|-------------|-------------|--------------|-------------|-------------|
| Argentina | 1.21 | 4.71 | -0.88 | 0.22 | 1.72 |
| Brazil | 0.81 | 3.20 | -1.96 | -0.50 | 10.23 |
| Chile | 2.06 | 7.61 | -0.33 | 0.00 | 0.39 |
| Egypt | 0.79 | 3.13 | -1.30 | -0.43 | 2.21 |
| Indonesia | 2.89 | 9.96 | -0.30 | 0.22 | 0.60 |
| Malaysia | 2.61 | 9.23 | -0.35 | 0.52 | 2.44 |
| Mexico | 2.06 | 7.59 | -0.31 | 0.47 | 0.73 |
| Pakistan | 1.35 | 5.21 | -1.10 | -0.29 | 2.97 |
| Philippines | 1.43 | 5.49 | -0.64 | -0.08 | 1.10 |
| Poland | 3.47 | 11.32 | -0.44 | -0.06 | 1.29 |
| South Africa | 3.47 | 11.32 | -0.44 | -0.06 | 1.29 |
| Thailand | 2.84 | 9.83 | -0.40 | -0.23 | 1.34 |
| Australia | 1.30 | 5.01 | -0.65 | 0.02 | -0.04 |
| Austria | 1.56 | 5.96 | -0.68 | 0.53 | 3.42 |
| Denmark | 3.32 | 10.99 | -0.22 | 0.46 | 1.13 |
| Finland | 2.50 | 8.91 | -0.45 | -0.01 | 1.47 |
| Germany | 1.87 | 6.97 | -0.59 | 0.50 | 1.87 |
| Israel | 1.97 | 7.32 | -0.71 | 0.94 | 7.10 |
| Italy | 2.09 | 7.69 | -0.93 | -0.88 | 5.85 |
| Norway | 2.57 | 9.09 | -0.41 | 0.21 | 0.15 |
| New Zealand | 2.26 | 8.21 | -0.79 | -0.30 | 2.28 |
| Singapore | 3.15 | 10.59 | -0.36 | 0.39 | 1.93 |
| Spain | 2.14 | 7.83 | -0.42 | 0.43 | 2.44 |
| Switzerland | 2.49 | 8.88 | -0.29 | 0.45 | 1.46 |
| Average | 2.18 | N/A | -0.62 | 0.11 | 2.31 |

Table 19: Value-weighted QMJ/Mkt.rf combo portfolio

The table below reports the summary statistics for value-weighted (39%) QMJ and Mkt-rf portfolios. The weight towards QMJ and Mkt is 50% respectively. The portfolios are rebalanced monthly and equally weighted. The alpha is calculated as the constant of a time-series regression of the portfolio excess returns (over the U.S. Treasury Bill) on the four factors, all alpha values are annualized. MKT are the market excess returns, SMB is the size factor, HML the value factor and UMD is the momentum factor. The Sharpe Ratio is calculated as the expected portfolio return of the portfolio standard deviation (not considering the risk-free due to the zero-cost nature of long-short portfolios). The second column reports the p-values of each Sharpe Ratios. Values significant on a 5% level are marked in bold. The sample period is from 1999 – 2017. Kurtosis is excess kurtosis.

| COUNTRY | SR | T-STATISTIC | MIN | SKEWNESS | KURTOSIS |
|--------------|-------------|-------------|--------------|--------------|-------------|
| Argentina | 0.54 | 2.16 | -4.73 | 0.48 | 4.40 |
| Brazil | 0.44 | 1.77 | -8.02 | -2.28 | 12.24 |
| Chile | 0.73 | 2.91 | -8.55 | -4.57 | 48.23 |
| Egypt | 0.38 | 1.52 | -6.32 | 0.20 | 3.25 |
| Indonesia | 1.00 | 3.93 | -2.49 | -0.39 | 0.60 |
| Malaysia | 1.29 | 4.97 | -11.30 | -2.66 | 29.89 |
| Mexico | 0.94 | 3.70 | -2.43 | 0.01 | 1.09 |
| Pakistan | 0.76 | 3.01 | -5.47 | -0.56 | 3.04 |
| Philippines | 0.60 | 2.37 | -4.30 | -1.04 | 2.73 |
| Poland | 1.78 | 6.71 | -1.46 | 0.78 | 2.39 |
| South Africa | 1.78 | 6.71 | -1.46 | 0.78 | 2.39 |
| Thailand | 1.17 | 4.55 | -2.34 | 0.09 | 0.69 |
| Australia | 0.85 | 3.37 | -1.65 | 0.80 | 4.17 |
| Austria | 0.94 | 3.68 | -1.77 | 1.36 | 7.97 |
| Denmark | 1.34 | 5.16 | -1.14 | 0.45 | 2.76 |
| Finland | 1.35 | 5.22 | -1.57 | 0.29 | 3.18 |
| Germany | 1.33 | 5.15 | -1.21 | 0.63 | 1.25 |
| Israel | 0.90 | 3.53 | -1.81 | 1.66 | 11.18 |
| Italy | 0.91 | 3.57 | -2.57 | 0.09 | 0.69 |
| Norway | 1.71 | 6.47 | -2.20 | -0.25 | 0.02 |
| New Zealand | 0.45 | 1.81 | -3.65 | -1.06 | 4.80 |
| Singapore | 1.56 | 5.95 | -2.05 | -0.25 | 0.79 |
| Spain | 0.88 | 3.48 | -3.61 | 0.36 | 2.84 |
| Switzerland | 1.26 | 4.89 | -2.87 | -0.86 | 2.14 |
| Average | 1.04 | N/A | -3.54 | -0.25 | 6.36 |

Table 20: Value-weighted QMJ/SMB combo portfolio

The table below reports the summary statistics for value-weighted (39%) QMJ and SMB portfolios. The weight towards QMJ and SMB is 50% respectively. The portfolios are rebalanced monthly and equally weighted. The alpha is calculated as the constant of a time-series regression of the portfolio excess returns (over the U.S. Treasury Bill) on the four factors, all alpha values are annualized. MKT are the market excess returns, SMB is the size factor, HML the value factor and UMD is the momentum factor. The Sharpe Ratio is calculated as the expected portfolio return of the portfolio standard deviation (not considering the risk-free due to the zero-cost nature of long-short portfolios). The second column reports the p-values of each Sharpe Ratios. Values significant on a 5% level are marked in bold. The sample period is from 1999 – 2017. Kurtosis is excess kurtosis.

| COUNTRY | SR | T-STATISTIC | MIN | SKEWNESS | KURTOSIS |
|--------------|-------------|-------------|--------------|--------------|-------------|
| Argentina | 0.50 | 1.99 | -4.42 | 0.62 | 4.17 |
| Brazil | 0.38 | 1.52 | -8.34 | -2.17 | 12.04 |
| Chile | 0.65 | 2.56 | -8.88 | -4.59 | 47.36 |
| Egypt | 0.34 | 1.35 | -6.57 | 0.25 | 3.40 |
| Indonesia | 0.91 | 3.58 | -2.65 | -0.42 | 0.65 |
| Malaysia | 1.23 | 4.77 | -11.52 | -2.83 | 30.38 |
| Mexico | 0.87 | 3.45 | -2.32 | -0.01 | 0.71 |
| Pakistan | 0.75 | 2.98 | -5.15 | -0.57 | 2.56 |
| Philippines | 0.53 | 2.12 | -4.06 | -0.88 | 2.16 |
| Poland | 1.69 | 6.41 | -1.98 | 0.72 | 2.53 |
| South Africa | 1.69 | 6.41 | -1.98 | 0.72 | 2.53 |
| Thailand | 1.04 | 4.05 | -2.94 | 0.03 | 0.82 |
| Australia | 0.70 | 2.79 | -1.79 | 0.99 | 4.55 |
| Austria | 0.76 | 2.99 | -2.37 | 1.30 | 7.93 |
| Denmark | 1.14 | 4.46 | -1.67 | 0.73 | 4.15 |
| Finland | 1.20 | 4.68 | -1.10 | 0.55 | 2.18 |
| Germany | 1.30 | 5.01 | -1.44 | 0.94 | 2.77 |
| Israel | 0.77 | 3.03 | -1.63 | 1.39 | 8.82 |
| Italy | 0.78 | 3.07 | -2.79 | 0.15 | 1.17 |
| Norway | 1.56 | 5.93 | -2.80 | -0.27 | 0.64 |
| New Zealand | 0.39 | 1.56 | -3.53 | -0.83 | 3.52 |
| Singapore | 1.34 | 5.18 | -2.48 | -0.17 | 1.66 |
| Spain | 0.78 | 3.09 | -3.78 | 0.25 | 2.47 |
| Switzerland | 1.01 | 3.97 | -3.46 | -0.77 | 2.85 |
| Average | 0.93 | N/A | -3.74 | -0.20 | 6.33 |

Table 21: Value-weighted QMJ/HML combo portfolio

The table below reports the summary statistics for value-weighted (39%) QMJ and HML portfolios. The weight towards QMJ and HML is 50% respectively. The portfolios are rebalanced monthly and equally weighted. The alpha is calculated as the constant of a time-series regression of the portfolio excess returns (over the U.S. Treasury Bill) on the four factors, all alpha values are annualized. MKT are the market excess returns, SMB is the size factor, HML the value factor and UMD is the momentum factor. The Sharpe Ratio is calculated as the expected portfolio return of the portfolio standard deviation (not considering the risk-free due to the zero-cost nature of long-short portfolios). The second column reports the p-values of each Sharpe Ratios. Values significant on a 5% level are marked in bold. The sample period is from 1999 – 2017. Kurtosis is excess kurtosis.

| COUNTRY | SR | T-STATISTIC | MIN | SKEWNESS | KURTOSIS |
|--------------|-------------|-------------|--------------|--------------|-------------|
| Argentina | 0.52 | 2.05 | -4.47 | 0.60 | 4.24 |
| Brazil | 0.41 | 1.62 | -8.24 | -2.16 | 12.02 |
| Chile | 0.69 | 2.71 | -8.64 | -4.50 | 46.14 |
| Egypt | 0.35 | 1.41 | -6.55 | 0.18 | 3.34 |
| Indonesia | 0.95 | 3.74 | -2.84 | -0.44 | 0.62 |
| Malaysia | 1.26 | 4.88 | -11.36 | -2.76 | 29.98 |
| Mexico | 0.90 | 3.54 | -2.36 | 0.07 | 0.81 |
| Pakistan | 0.76 | 3.01 | -5.19 | -0.53 | 2.49 |
| Philippines | 0.55 | 2.20 | -4.19 | -0.94 | 2.48 |
| Poland | 1.76 | 6.62 | -1.69 | 0.85 | 2.93 |
| South Africa | 1.76 | 6.62 | -1.69 | 0.85 | 2.93 |
| Thailand | 1.07 | 4.19 | -2.76 | 0.03 | 0.80 |
| Australia | 0.75 | 2.96 | -1.56 | 1.15 | 5.37 |
| Austria | 0.80 | 3.16 | -2.19 | 1.52 | 8.66 |
| Denmark | 1.23 | 4.76 | -1.49 | 0.95 | 5.30 |
| Finland | 1.29 | 5.00 | -1.25 | 0.69 | 3.00 |
| Germany | 1.35 | 5.20 | -1.26 | 1.06 | 2.97 |
| Israel | 0.80 | 3.15 | -1.71 | 1.32 | 8.15 |
| Italy | 0.84 | 3.32 | -2.62 | 0.13 | 1.10 |
| Norway | 1.59 | 6.03 | -2.61 | -0.21 | 0.51 |
| New Zealand | 0.42 | 1.69 | -3.43 | -0.65 | 3.16 |
| Singapore | 1.36 | 5.24 | -2.67 | -0.19 | 2.12 |
| Spain | 0.83 | 3.29 | -3.70 | 0.32 | 2.73 |
| Switzerland | 1.09 | 4.25 | -3.28 | -0.74 | 2.81 |
| Average | 0.97 | N/A | -3.66 | -0.14 | 6.44 |

Table 22: Value-weighted rainbow portfolio

The table below reports the summary statistics for a portfolio including value-weighted QMJ, Mkt-rf, HML and SMB. The weights towards each factor have been chosen by maximizing the overall Sharpe ratios, using Excel Solver. The portfolios are rebalanced monthly and equally weighted. The alpha is calculated as the constant of a time-series regression of the portfolio excess returns (over the U.S. Treasury Bill) on the four factors, all alpha values are annualized. MKT are the market excess returns, SMB is the size factor, HML the value factor and UMD is the momentum factor. The Sharpe Ratio is calculated as the expected portfolio return of the portfolio standard deviation (not considering the risk-free due to the zero-cost nature of long-short portfolios). The second column reports the p-values of each Sharpe Ratios. Values significant on a 5% level are marked in bold. The sample period is from 1999 – 2017. Kurtosis is excess kurtosis.

| COUNTRY | SR | T-STATISTIC | MIN | SKEWNESS | KURTOSIS |
|----------------|-------------|-------------|--------------|--------------|-------------|
| Argentina | 0.93 | 3.64 | -0.59 | 0.62 | 3.15 |
| Brazil | 0.91 | 3.56 | -1.12 | -1.73 | 8.68 |
| Chile | 1.23 | 4.78 | -0.93 | -1.23 | 9.27 |
| Egypt | 0.82 | 3.24 | -0.73 | 0.38 | 2.56 |
| Indonesia | 1.46 | 5.61 | -0.49 | -0.37 | 1.03 |
| Malaysia | 1.63 | 6.17 | -1.39 | -1.49 | 15.35 |
| Mexico | 1.32 | 5.11 | -0.37 | 0.25 | 1.18 |
| Pakistan | 1.12 | 4.38 | -0.69 | -0.21 | 0.84 |
| Philippines | 1.15 | 4.47 | -0.42 | -0.25 | 0.13 |
| Poland | 2.05 | 7.57 | -0.32 | 0.41 | 1.34 |
| South Africa | 2.05 | 7.57 | -0.32 | 0.41 | 1.34 |
| Thailand | 1.62 | 6.16 | -0.30 | 0.20 | 0.25 |
| Australia | 1.34 | 5.16 | -0.28 | 0.68 | 2.89 |
| Austria | 1.56 | 5.95 | -0.23 | 0.33 | 1.18 |
| Denmark | 1.70 | 6.41 | -0.22 | 0.06 | 0.80 |
| Finland | 1.45 | 5.56 | -0.42 | -0.01 | 1.50 |
| Germany | 1.37 | 5.28 | -0.37 | 0.24 | 0.50 |
| Israel | 1.24 | 4.82 | -0.39 | 0.45 | 1.57 |
| Italy | 1.51 | 5.76 | -0.39 | -0.06 | 0.77 |
| Norway | 2.06 | 7.60 | -0.36 | 0.03 | 0.03 |
| New Zealand | 1.05 | 4.11 | -0.52 | -0.42 | 1.49 |
| Singapore | 1.92 | 7.15 | -0.28 | 0.09 | 0.17 |
| Spain | 1.41 | 5.42 | -0.55 | -0.04 | 2.16 |
| Switzerland | 1.77 | 6.66 | -0.28 | 0.03 | 0.87 |
| Average | 1.44 | N/A | -0.50 | -0.07 | 2.46 |

Table 23: Regression results high-volatility, high-Quality strategy

The table below reports the high-volatility, high-quality portfolio alphas, factor loadings and Sharpe Ratios for the emerging countries. The portfolios in the first 12 rows below are equally weighted and the remaining ones are value-weighted all portfolios go long in the top 30% and short in the bottom 30% of the stocks according to their quality score. The portfolios are rebalanced monthly. The alpha is calculated as the constant of a time-series regression of the portfolio excess returns (over the U.S. Treasury Bill) on the four factors, all alpha values are annualized. MKT are the market excess returns, SMB is the size factor, HML the value factor and UMD is the momentum factor. The Sharpe Ratio is calculated as the expected portfolio return of the portfolio standard deviation (not considering the risk-free due to the zero-cost nature of long-short portfolios). The last column reports the p-values of each Sharpe Ratios. Values significant on a 5% level are marked in bold. The sample period is from 1999 – 2017.

| COUNTRY | CAPM ALPHA | P-VALUE | 4-FACTOR ALPHA | P-VALUE | FACTOR LOADINGS | | | | SR | P-VALUE |
|--------------|-------------|---------|----------------|---------|-----------------|-------|-------|-------|-------------|---------|
| | | | | | MKT | SMB | HML | UMD | | |
| Argentina | 0.79 | 0.00 | 0.69 | 0.00 | 0.31 | 0.98 | 0.20 | 0.50 | 1.39 | 0.00 |
| Brazil | 0.58 | 0.00 | 0.62 | 0.00 | -0.41 | -3.36 | 0.17 | 0.50 | 0.67 | 0.01 |
| Chile | 0.51 | 0.00 | 0.46 | 0.00 | -0.31 | -0.32 | 0.29 | 0.48 | 1.91 | 0.00 |
| Egypt | 0.64 | 0.00 | 0.60 | 0.00 | 0.31 | 0.64 | -0.12 | 0.32 | 0.96 | 0.00 |
| Indonesia | 0.98 | 0.00 | 1.01 | 0.00 | 0.34 | -0.50 | -1.07 | 0.22 | 1.89 | 0.00 |
| Malaysia | 0.69 | 0.00 | 0.70 | 0.00 | 0.13 | -0.28 | -0.70 | 0.27 | 3.07 | 0.00 |
| Mexico | 0.58 | 0.00 | 0.66 | 0.00 | 0.27 | -0.80 | -1.18 | -0.24 | 1.54 | 0.00 |
| Pakistan | 0.92 | 0.00 | 0.90 | 0.00 | 0.18 | 1.34 | -0.39 | -0.05 | 1.86 | 0.00 |
| Philippines | 0.46 | 0.00 | 0.40 | 0.00 | -0.03 | -0.78 | 0.72 | 0.64 | 0.99 | 0.00 |
| Poland | 1.12 | 0.00 | 1.20 | 0.00 | 0.12 | -0.73 | -0.01 | 0.17 | 3.86 | 0.00 |
| South Africa | 0.87 | 0.00 | 0.89 | 0.00 | -0.03 | 0.34 | -0.82 | -0.07 | 2.36 | 0.00 |
| Thailand | 0.88 | 0.00 | 0.90 | 0.00 | 0.31 | 0.34 | -0.87 | 0.05 | 3.48 | 0.00 |
| Argentina | 0.48 | 0.01 | 0.36 | 0.04 | 0.34 | 0.63 | -0.77 | 1.66 | 0.61 | 0.02 |
| Brazil | 0.53 | 0.00 | 0.49 | 0.00 | 0.13 | 0.10 | 0.56 | 0.33 | 0.85 | 0.00 |
| Chile | 0.47 | 0.00 | 0.49 | 0.00 | -0.70 | 0.60 | -0.87 | 0.05 | 0.79 | 0.00 |
| Egypt | 0.51 | 0.01 | 0.46 | 0.02 | -0.12 | 0.23 | 0.67 | 0.30 | 0.59 | 0.02 |
| Indonesia | 0.80 | 0.00 | 0.83 | 0.00 | 0.79 | -0.84 | -1.58 | 0.50 | 1.11 | 0.00 |
| Malaysia | 0.70 | 0.00 | 0.73 | 0.00 | -0.23 | -0.58 | -0.81 | 0.19 | 1.66 | 0.00 |
| Mexico | 0.63 | 0.00 | 0.83 | 0.00 | -0.19 | 0.79 | -0.70 | -2.39 | 0.99 | 0.00 |
| Pakistan | 0.89 | 0.00 | 0.88 | 0.00 | 0.08 | 0.73 | -0.67 | 0.06 | 1.30 | 0.00 |
| Philippines | 0.48 | 0.00 | 0.53 | 0.00 | -0.68 | -0.98 | -1.23 | 0.22 | 0.66 | 0.01 |
| Poland | 0.87 | 0.00 | 0.84 | 0.00 | 0.31 | -1.15 | 1.22 | 0.23 | 2.09 | 0.00 |
| South Africa | 0.57 | 0.00 | 0.59 | 0.00 | 0.64 | 0.06 | -1.17 | 0.31 | 1.13 | 0.00 |
| Thailand | 0.53 | 0.00 | 0.54 | 0.00 | 0.75 | -0.04 | -2.18 | 0.79 | 1.18 | 0.00 |

Table 24: Summary statistics high-volatility, high-quality strategy

The table below shows the respective summary statistics for the portfolios from the table above. Kurtosis is excess kurtosis.

| COUNTRY | EXCESS RETURN | T- STATISTIC | STD.DEV | MIN | SKEWNESS | KURTOSIS |
|--------------|---------------|--------------|---------|--------|----------|----------|
| Argentina | 0.80 | 5.58 | 0.57 | -2.80 | 1.85 | 10.22 |
| Brazil | 0.56 | 2.69 | 0.84 | -11.27 | -0.70 | 8.46 |
| Chile | 0.48 | 7.64 | 0.25 | -2.31 | 0.08 | 1.34 |
| Egypt | 0.65 | 3.86 | 0.67 | -7.29 | 0.50 | 3.40 |
| Indonesia | 0.99 | 7.55 | 0.53 | -5.05 | -0.22 | 1.19 |
| Malaysia | 0.69 | 12.28 | 0.22 | -2.54 | -0.24 | 1.47 |
| Mexico | 0.60 | 6.15 | 0.39 | -2.76 | 0.54 | 1.69 |
| Pakistan | 0.92 | 7.43 | 0.50 | -4.52 | 0.06 | 0.42 |
| Philippines | 0.45 | 3.97 | 0.46 | -4.71 | -0.68 | 1.21 |
| Poland | 1.20 | 15.43 | 0.31 | -1.84 | 0.38 | 1.26 |
| South Africa | 0.87 | 9.43 | 0.37 | -2.37 | -0.03 | -0.05 |
| Thailand | 0.89 | 13.94 | 0.26 | -1.49 | 0.24 | 0.32 |
| Argentina | 0.47 | 2.44 | 0.77 | -7.53 | 0.37 | 2.45 |
| Brazil | 0.53 | 3.41 | 0.63 | -11.57 | -1.10 | 5.95 |
| Chile | 0.43 | 3.16 | 0.54 | -18.10 | -4.61 | 50.13 |
| Egypt | 0.50 | 2.37 | 0.85 | -17.81 | -1.45 | 7.83 |
| Indonesia | 0.84 | 4.46 | 0.75 | -9.03 | -0.27 | 1.04 |
| Malaysia | 0.69 | 6.66 | 0.41 | -3.54 | 0.98 | 3.44 |
| Mexico | 0.65 | 3.96 | 0.66 | -6.26 | 1.81 | 14.09 |
| Pakistan | 0.88 | 5.19 | 0.68 | -9.76 | 0.42 | 4.78 |
| Philippines | 0.44 | 2.64 | 0.67 | -7.39 | -0.29 | 1.83 |
| Poland | 0.90 | 8.36 | 0.43 | -3.23 | 0.38 | 0.78 |
| South Africa | 0.60 | 4.52 | 0.53 | -6.41 | -0.34 | 1.37 |
| Thailand | 0.55 | 4.72 | 0.47 | -8.74 | -1.20 | 6.31 |

Table 25: ESG factor portfolios

The table below reports the summary statistics and 4-factor alphas for the long/short ESG portfolios and the all-long indices. The top part of the table reports the values for all 1/3 long and 1/3 short portfolios and the bottom part of the table reports the values for the 10% long and 10% short portfolios. The portfolios are rebalanced monthly. The alpha is calculated as the constant of a time-series regression of the portfolio excess returns (over the U.S. Treasury Bill) on the four factors, all alpha values are annualized. MKT are the market excess returns, SMB is the size factor, HML the value factor and UMD is the momentum factor. The Sharpe Ratio is calculated as the expected portfolio return of the portfolio standard deviation (not considering the risk-free for the long/short portfolios and assumed to be 2% for the long-only portfolios). Values significant on a 5% level are marked in bold. The sample period is from 2001 – 2017.

| INDEX | SR | MIN | SKEWNESS | KURTOSIS | 4- FACTOR ALPHA | P- VALUE |
|----------------------|-------|-------|----------|----------|-----------------------|-------------|
| ASX 200 | 0.63 | -0.67 | -0.76 | 4.63 | N/A | N/A |
| ASX 200 ESG | -0.63 | -0.14 | -0.61 | 2.51 | -0.12 | 0.00 |
| S&P 500 | 0.44 | -0.65 | -0.57 | 3.16 | N/A | N/A |
| S&P 500 ESG | 0.00 | -0.03 | 0.16 | 0.26 | 0.00 | 0.77 |
| EUROSTOXX 600 | 0.33 | -0.52 | -0.87 | 1.87 | N/A | N/A |
| EUROSTOXX 600 ESG | 0.43 | -0.03 | 1.16 | 3.86 | 0.02 | 0.04 |
| Nikkei 300 | 0.14 | -0.44 | -0.19 | 0.41 | N/A | N/A |
| Nikkei 300 ESG | 0.06 | -0.05 | 0.11 | 1.59 | 0.01 | 0.78 |
| ASX 200 | 0.66 | -2.23 | -0.80 | 5.06 | N/A | N/A |
| ASX 200 ESG | -0.78 | -0.26 | -0.63 | 2.06 | -0.12 | 0.00 |
| S&P 500 | 0.48 | -2.17 | -0.57 | 3.16 | N/A | N/A |
| S&P 500 ESG | 0.07 | -0.06 | 0.49 | 0.35 | 0.01 | 0.69 |
| EUROSTOXX 600 | 0.37 | -1.75 | -0.87 | 1.88 | N/A | N/A |
| EUROSTOXX 600 ESG | 0.18 | -0.06 | 1.42 | 5.35 | 0.03 | 0.18 |
| Nikkei 300 | 0.17 | -1.47 | -0.18 | 0.43 | N/A | N/A |
| Nikkei 300 ESG | 0.02 | -0.13 | -0.10 | 2.64 | 0.00 | 0.99 |

Code Appendix

Code 1: Code for the fixed effects price of quality regressions, exemplary for the developed markets sample

```
clc; clearvars; close all;
```

```
%% Importing data
```

```
PD = readtable('DevelopedFE.xlsx','Sheet','2017','Range','A1:X2812');
PD.Properties.VariableNames([1]) = {'CompanyCode'};
```

```
%% Industry Fixed Effects
```

```
W = [PD.Quality, PD.x10, PD.x15, PD.x20, PD.x25, PD.x30, PD.x35, PD.x40, PD.x45, PD.x50,
PD.x55];
Z = PD.MtB;
T = length(PD.CompanyCode);
% White's correction
CorrectionWIND = table();
const = 1; % 1: constant is included
lags = 12; % 12 lags
[beta, tstat, ~, vz, ~, RbarIND, ~] = olsnw(Z, W, const, lags);
CorrectionWIND.beta = beta;
CorrectionWIND.SE = sqrt(diag(vz));
CorrectionWIND.tstat = tstat;
CorrectionWIND.p = 2*(1-tcdf(abs(tstat),T-2));
CorrectionWIND.Properties.RowNames = {'(Intercept)', 'Quality', '10', '15', '20', '25', '30', '35', '40',
'45', '50', '55'};
CorrectionWIND;
```

```
%% Country Fixed Effects
```

```
W = [PD.Quality, PD.AUT, PD.ISR, PD.AUS, PD.FIN, PD.CHE, PD.NOR, PD.NZL, PD.ESP,
PD.ITA, PD.DEU, PD.SGP];
Z = PD.MtB;
T = length(PD.CompanyCode);
```

```
% White's correction
```

```
CorrectionWCOU = table();
const = 1; % 1: constant is included
lags = 12; % 12 lags
[beta, tstat, ~, vz, ~, RbarCOU, ~] = olsnw(Z, W, const, lags);
CorrectionWCOU.beta = beta;
CorrectionWCOU.SE = sqrt(diag(vz));
CorrectionWCOU.tstat = tstat;
CorrectionWCOU.p = 2*(1-tcdf(abs(tstat),T-2));
CorrectionWCOU.Properties.RowNames = {'(Intercept)', 'Quality', 'AUT', 'ISR', 'AUS', 'FIN', 'CHE',
'NOR', 'NZL', 'ESP', 'ITA', 'DEU', 'SGP'};
CorrectionWCOU;
```

```
%% Country & Industry Fixed Effects
```

```
W = [PD.Quality, PD.x10, PD.x15, PD.x20, PD.x25, PD.x30, PD.x35, PD.x40, PD.x45, PD.x50,
PD.x55, PD.AUT, PD.ISR, PD.AUS, PD.FIN, PD.CHE, PD.NOR, PD.NZL, PD.ESP, PD.ITA,
PD.DEU, PD.SGP];
Z = PD.MtB;
T = length(PD.CompanyCode);
% White's correction
CorrectionWFE = table();
const = 1; % 1: constant is included
lags = 12; % 12 lags
[beta, tstat, ~, vz, ~, RbarFE, ~] = olsnw(Z, W, const, lags);
CorrectionWFE.beta = beta;
```

```
CorrectionWFE.SE = sqrt(diag(vz));
CorrectionWFE.tstat = tstat;
CorrectionWFE.p = 2*(1-tcdf(abs(tstat),T-2));
CorrectionWFE.Properties.RowNames = {'(Intercept)', 'Quality', '10', '15', '20', '25', '30', '35', '40', '45',
'50', '55', 'AUT', 'ISR', 'AUS', 'FIN', 'CHE', 'NOR', 'NZL', 'ESP', 'ITA', 'DEU', 'SGP'};
CorrectionWFE;
```

Code 2: Code for the diagnostic tests, exemplary for the developed markets sample and the price of quality regression

```

clc; clearvars; close all;

%% Importing data
PD = readtable('Developed.xlsx','Sheet','2017','Range','A1:F2812');
PD.Properties.VariableNames([1]) = {'CompanyCode'};

%% Regression
%Quality
resultsQ = regstats(PD.MtB,[PD.Quality]);
labels = {'Const','Quality'};
betasQ = resultsQ.beta;
tstatQ = resultsQ.tstat.t;
r2Q = resultsQ.rsquare;
adjr2Q = resultsQ.adjrsquare;
URSSQ = resultsQ.fstat.sse;
T = length(PD.CompanyCode);
alpha = 0.05;

%Profitability, Growth & Safety
resultsPGS = regstats(PD.MtB,[PD.Profitability PD.Growth PD.Safety]);
labels = {'Const','Pro','Gro','Saf'};
betasPGS = resultsPGS.beta;
tstatPGS = resultsPGS.tstat.t;
adjr2PGS = resultsPGS.adjrsquare;
URSSPGS = resultsPGS.fstat.sse;

%% Fitlm

% Fitlm was used to check the results
% and stored all the outputs in unr_regr.SSE.

%Quality
input=PD(:,[4:5]);
uQ = resultsQ.r; % residuals
unr_regrQ = fitlm([PD.Quality],PD.MtB);
URSS1 = unr_regrQ.SSE;
T1 = unr_regrQ.NumObservations;
kQ = unr_regrQ.NumEstimatedCoefficients;

%Profitability, Growth & Safety
input=PD(:,[2:3 5]);
uPGS = resultsPGS.r; % residuals
unr_regrPGS = fitlm([PD.Profitability PD.Growth PD.Safety],PD.MtB);
URSS1 = unr_regrPGS.SSE;
T1 = unr_regrPGS.NumObservations;
kPGS = unr_regrPGS.NumEstimatedCoefficients;

%% First CLRM Assumption
% Assumption 1:  $E(u_t) = 0$ 
% The average value of errors is zero

%Quality
Mean_ResidualsQ=mean(unr_regrQ.Residuals.Raw);
Stdev_ResidualsQ=std(unr_regrQ.Residuals.Raw);

% test statistic
tStat_FAQ=(Mean_ResidualsQ)/(Stdev_ResidualsQ/sqrt(T));

% Critical Value at 5%
CValueFAQ=tinvt(1-1/2*alpha,T-kQ);

% p-value

```

```

PvSAQ=2*(1-tcdf(abs(tStat_FAQ),T-kQ));

% test if H0 should be rejected
rejectFAQ = abs(tStat_FAQ) > abs(CValueFAQ);

%PGS
Mean_ResidualsPGS=mean(unr_regrPGS.Residuals.Raw);
Stdev_ResidualsPGS=std(unr_regrPGS.Residuals.Raw);

% test statistic
tStat_FAPGS=(Mean_ResidualsPGS)/(Stdev_ResidualsPGS/sqrt(T));

% Critical Value at 5%
CValueFAPGS=tinv(1-1/2*alpha,T-kPGS);

% p-value
PvFAPGS=2*(1-tcdf(abs(tStat_FAPGS),T-kPGS));

% test if H0 should be rejected
rejectFAPGS = abs(tStat_FAPGS) > abs(CValueFAPGS);
%% Second CLRM Assumption
% Assumption 2: var(ut) = ?2 < ?
% The variance of errors is constant (homoscedasticity)

%Quality

% White's test
ResRawQ = unr_regrQ.Residuals.Raw;
PD.ResRaw2Q = uQ.^2;

% Create a table with the constant and squared terms
PD2Q = table(PD.MtB, PD.Quality, PD.MtB.^2, PD.Quality.^2, PD.ResRaw2Q);

% Insert variable names
PD2Q.Properties.VariableNames={'MtB','Quality','MtBsq','Qualitysq','ResRaw2Q'};

% Unrestricted White regression
WhiteRegQ=fitlm(PD2Q,'ResRaw2Q~Quality+Qualitysq');

% LM-test (Lagrange-Multiplier)
mQ = kQ - 1 ;
tstat_SAQ = WhiteRegQ.Rsquared.Ordinary*T;
cvalue_SAQ = chi2inv(1 - alpha , mQ);
pv_SAQ = 1 - cdf('Chisquare' , tstat_SAQ , mQ);
reject_SAQ = tstat_SAQ > cvalue_SAQ;

%PGS

% White's test
ResRawPGS = unr_regrPGS.Residuals.Raw;
PD.ResRaw2PGS = uPGS.^2;

% Create a table with the constant and squared terms
PD2PGS = table(PD.MtB, PD.Profitability, PD.Growth, PD.Safety, PD.MtB.^2, PD.Profitability.^2,
PD.Growth.^2, PD.Safety.^2, PD.ResRaw2PGS);

% Insert variable names
PD2PGS.Properties.VariableNames={'MtB','Profitability', 'Growth', 'Safety', 'MtBsq','Profitabilitysq',
'Safety^2', 'Growthsq', 'ResRaw2PGS'};

% Unrestricted White regression
WhiteRegPGS=fitlm(PD2PGS,'ResRaw2PGS~Profitability+Growth+Safety+Profitabilitysq+Growth
sq+Safety^2');

```

```

% LM-test (Lagrange-Multiplier)
mPGS = kPGS - 1 ;
tstat_SAPGS = WhiteRegPGS.Rsquared.Ordinary*T;
cvalue_SAPGS = chi2inv(1 - alpha , mPGS);
pv_SAPGS = 1 - cdf('Chisquare' , tstat_SAPGS , mPGS);
reject_SAPGS = tstat_SAPGS > cvalue_SAPGS;

%% White's correction

Z = PD.MtB;
const = 1; % 1: constant is included
lags = 12; % 12 lags to correct for autocorrelation

%Quality
Q = [PD.Quality];
CorrectionWQ = table();
[betaWQ, tstatWQ, ~, vzWQ, ~, RbarWQ, ~ ] = olsnw(Z, Q, const, lags);
CorrectionWQ.beta = betaWQ;
CorrectionWQ.SE = sqrt(diag(vzWQ));
CorrectionWQ.tstat = tstatWQ;
CorrectionWQ.p = 2*(1-tcdf(abs(tstatWQ),T-2));
CorrectionWQ.Properties.RowNames = {'(Intercept)', 'Quality'};
CorrectionWQ;

%PGS
PGS = [PD.Profitability, PD.Growth, PD.Safety];
CorrectionWPGS = table();
[betaWPGS, tstatWPGS, ~, vzWPGS, ~, RbarWPGS, ~ ] = olsnw(Z, PGS, const, lags);
CorrectionWPGS.beta = betaWPGS;
CorrectionWPGS.SE = sqrt(diag(vzWPGS));
CorrectionWPGS.tstat = tstatWPGS;
CorrectionWPGS.p = 2*(1-tcdf(abs(tstatWPGS),T-2));
CorrectionWPGS.Properties.RowNames = {'(Intercept)', 'Profitability', 'Growth', 'Safety'};
CorrectionWPGS;

%% Third CLRM Assumption
% Assumption 3: cov(ui , u j ) = 0 for i _= j
% The covariance between the error terms over time is zero, the errors are uncorrelated

%Quality

PD.uQ = uQ;
PD.uQ1 = lagmatrix(uQ,1);
PD.uQ2 = lagmatrix(uQ,2);
PD.uQ3 = lagmatrix(uQ,3);
PD.uQ4 = lagmatrix(uQ,4);
PD.uQ5 = lagmatrix(uQ,5);
PD.uQ6 = lagmatrix(uQ,6);
PD.uQ7 = lagmatrix(uQ,7);
PD.uQ8 = lagmatrix(uQ,8);
PD.uQ9 = lagmatrix(uQ,9);
PD.uQ10 = lagmatrix(uQ,10);
PD.uQ11 = lagmatrix(uQ,11);
PD.uQ12 = lagmatrix(uQ,12);

% Setting all nan's to zero
PD = fillmissing(PD, 'constant', 0, 'DataVariables', {'uQ', ...
'uQ1', 'uQ2', 'uQ3', 'uQ4', 'uQ5', 'uQ6', 'uQ7', 'uQ8', 'uQ9', 'uQ10', 'uQ11', 'uQ12'});

% New linear regression model
Breusch_Godfrey_regr = fitlm(PD, 'uQ ~ Quality + uQ1 + uQ2 + uQ3 + uQ4 + uQ5 + uQ6 +
uQ7 + uQ8 + uQ9 + uQ10 + uQ11 + uQ12');

```

```

% Chi-square test
r = 12;
test_TAQ = Breusch_Godfrey_regr.Rsquared.Ordinary * (T - r);
crit_TAQ = chi2inv(1-1/2*alpha, r);
pTAQ = 1 - cdf('Chisquare', test_TAQ, r);
rejectTAQ = test_TAQ > crit_TAQ;

% F-test
cgQ = zeros(14,1);
HgQ = zeros(14);
HgQ(3,3) = 1;
HgQ(4,4) = 1;
HgQ(5,5) = 1;
HgQ(6,6) = 1;
HgQ(7,7) = 1;
HgQ(8,8) = 1;
HgQ(9,9) = 1;
HgQ(10,10) = 1;
HgQ(11,11) = 1;
HgQ(12,12) = 1;
HgQ(13,13) = 1;
HgQ(14,14) = 1;

[PTAQ, FTAQ] = coefTest(Breusch_Godfrey_regr, HgQ, cgQ);

%PGS

PD.uPGS = uPGS;
PD.uPGS1 = lagmatrix(uPGS,1);
PD.uPGS2 = lagmatrix(uPGS,2);
PD.uPGS3 = lagmatrix(uPGS,3);
PD.uPGS4 = lagmatrix(uPGS,4);
PD.uPGS5 = lagmatrix(uPGS,5);
PD.uPGS6 = lagmatrix(uPGS,6);
PD.uPGS7 = lagmatrix(uPGS,7);
PD.uPGS8 = lagmatrix(uPGS,8);
PD.uPGS9 = lagmatrix(uPGS,9);
PD.uPGS10 = lagmatrix(uPGS,10);
PD.uPGS11 = lagmatrix(uPGS,11);
PD.uPGS12 = lagmatrix(uPGS,12);

% Setting all nan's to zero
PD = fillmissing(PD, 'constant', 0, 'DataVariables', {'uPGS', ...
'uPGS1', 'uPGS2', 'uPGS3', 'uPGS4', 'uPGS5', 'uPGS6', 'uPGS7', 'uPGS8', 'uPGS9', 'uPGS10',
'uPGS11', 'uPGS12'});

% New linear regression model
Breusch_Godfrey_regr = fitlm(PD, 'uPGS ~ Profitability + Growth + Safety + uPGS1 + uPGS2 +
uPGS3 + uPGS4 + uPGS5 + uPGS6 + uPGS7 + uPGS8 + uPGS9 + uPGS10 + uPGS11 +
uPGS12');

% Chi-square test
r = 12;
test_TAPGS = Breusch_Godfrey_regr.Rsquared.Ordinary * (T - r);
crit_TAPGS = chi2inv(1-1/2*alpha, r);
pTAPGS = 1 - cdf('Chisquare', test_TAPGS, r);
rejectTAPGS = test_TAPGS > crit_TAPGS;

% F-test
cgPGS = zeros(16,1);
HgPGS = zeros(16);
HgPGS(5,5) = 1;
HgPGS(6,6) = 1;

```

```

HgPGS(7,7) = 1;
HgPGS(8,8) = 1;
HgPGS(9,9) = 1;
HgPGS(10,10) = 1;
HgPGS(11,11) = 1;
HgPGS(12,12) = 1;
HgPGS(13,13) = 1;
HgPGS(14,14) = 1;
HgPGS(15,15) = 1;
HgPGS(16,16) = 1;

[PTAPGS, FTAPGS] = coefTest(Breusch_Godfrey_regr, HgPGS, cgPGS);

%% Fourth CLRM Assumption
% Assumption 4: the xt are non-stochastic
% OLS estimators are consistent and unbiased if regressors are not correlated with the error term

%Quality
correlation_Quality_u = corr(PD.Quality,uQ);

%PGS
correlation_Profitability_u = corr(PD.Profitability,uPGS);
correlation_Growth_u = corr(PD.Growth,uPGS);
correlation_Safety_u = corr(PD.Safety,uPGS);

%% Fifth CLRM Assumption
% Assumption 5: the disturbances are normally distributed

% Jarque-Bera test

%Quality
skew_Jarque_Bera_testQ = mean(uQ.^3) / mean(uQ.^2).^(3/2);
kurt_Jarque_Bera_testQ = mean(uQ.^4) / mean(uQ.^2).^2;
test_stat_Jarque_Bera_testQ = T * ( skew_Jarque_Bera_testQ^2 / 6 + (kurt_Jarque_Bera_testQ -
3)^2 / 24);
crit_val_Jarque_Bera_testQ = chi2inv(1-1/2*alpha, 2);
p_Jarque_Bera_testQ = 1 - cdf('Chisquare', test_stat_Jarque_Bera_testQ, 2);
reject_Jarque_Bera_testQ = test_stat_Jarque_Bera_testQ > crit_val_Jarque_Bera_testQ;

%PGS
skew_Jarque_Bera_testPGS = mean(uPGS.^3) / mean(uPGS.^2).^(3/2);
kurt_Jarque_Bera_testPGS = mean(uPGS.^4) / mean(uPGS.^2).^2;
test_stat_Jarque_Bera_testPGS = T * ( skew_Jarque_Bera_testPGS^2 / 6 +
(kurt_Jarque_Bera_testPGS - 3)^2 / 24);
crit_val_Jarque_Bera_testPGS = chi2inv(1-1/2*alpha, 2);
p_Jarque_Bera_testPGS = 1 - cdf('Chisquare', test_stat_Jarque_Bera_testPGS, 2);
reject_Jarque_Bera_testPGS = test_stat_Jarque_Bera_testPGS > crit_val_Jarque_Bera_testPGS;

%% Multicollinearity

%PGS
x1 = table(PD.Profitability, PD.Growth, PD.Safety);
x1.Properties.VariableNames = {'Profitability','Growth','Safety'};
corrplot(x1)
correlations = corrcoef(PGS);

```